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## CONTENTS.


| | PAGE |
|---|---|
| ARTICLES. | |
| 1. Earthquakes and Electricity. By Col. ARTHUR PARNELL, late Royal Engineers .. .. | 1 |
| 2. Canine Intelligence By C. LLOYD MORGAN .. .. .. | 10 |
| 3. The Sun-Spots and the Zodiacal Light. By A. H. SWINTON .. .. .. .. .. .. | 19 |
| 4, Baron Nordenskjœld's Greenland Expedition. By Count O. RICHTENSTEIN.. .. .. | 21 |
| 5. The Potassium Nitrite Outcry | 27 |
| 6. On the Hybridisation of Amphibians and the Principles of Reproduction .. .. .. | 30 |
| ARTICLES—*continued.* | |
| 7. Dr. Meldon's Electric Motor | 37 |
| ANALYSES OF BOOKS. | |
| Evolution and Natural Theology | 40 |
| To all the Invisible Gods: concerning two distinct Bibles being composed in the one Bible .. | 43 |
| Records of the Geological Survey of India .. .. .. .. | 44 |
| The English Illustrated Magazine | 45 |
| Association for the Improvement of Geometrical Teaching. The Elements of Plane Geometry.. | 46 |
| CORRESPONDENCE .. .. .. .. | 47 |
| NOTES.. .. .. .. .. .. .. | 51 |


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THE

# JOURNAL OF SCIENCE.

JANUARY, 1884.

## I. EARTHQUAKES AND ELECTRICITY.

By Colonel ARTHUR PARNELL, late Royal Engineers.

(Concluded from vol. v., page 706.)

IN "A Practical Treatise on Lightning Protection," by Henry W. Spang (Philadelphia, 1877), it is stated that Mr. Cromwell Varley, F.R.S. (whose lamented death has recently taken place), was of opinion that some earthquakes are due to subterraneous electrical discharges. He had found that powerful positive currents rushed through the Anglo-American cables towards England a few minutes before and a few minutes after the shocks of March 17th, 1871 (p. 29).

In "Nature" (No. 247, vol. x., 1874) Mr. H. H. Howorth expresses his opinion that the earth is shrinking about its equatorial region, and is being thrust out in the direction of the Poles; and he thinks that the distribution of this force may correspond with that of terrestrial magnetism. He quotes from Dr. Zöllner's paper in the "Philosophical Magazine," wherein it is stated that Kriel has given many instances of the coincidence of earthquakes with magnetic disturbances. Volcanoes are, according to Mr. Howorth, the mediate results of the shrinking of the earth; "earthquakes, on the contrary, are its immediate results, and go far to prove that terrestrial magnetism is to be correlated with the force which is shrinking the earth."

The article in the "Quarterly Review" for July, 1881, already mentioned, states that the most certain characters and accompaniments of earthquakes appear to be their

suddenness, the stifling heat and electric state of the atmosphere, and the sudden roar as of distant artillery. Dr. Schmidt, the Government Astronomer at Athens, in his researches on the Grecian earthquakes of 1840 to 1878, arrives at the result that the great ones had almost invariably a direction from N.E. to S.W. The reviewer says that the same fact has also been noticed in regard to severe shocks in America in 1870; and he then asks "Is not this the line of path habitually followed by electric currents?" After further discussion on the physical action of earthquakes, he says—"Considering the irresistible force, the unmeasured rapidity, the quick repetition, and the long duration of the shocks, what known agent in Nature, we would ask, except Electricity, is capable of producing at the same time such singular effects in the sea and such tremendous results on land?" Lyell and other authors have mentioned, but without laying on the occurrence the stress it deserves, the state of the atmosphere before an earthquake as densely charged with electricity. "The vicinity of hot springs, volcanoes, and mud lakes, regions of intense heat and centres of the electric influence, are the special haunts of the earthquake, and Science has pretty well proved that heat and electricity are convertible." All the circumstances inseparably connected with earthquakes point to the conclusion "that an earthquake is the result of discharges of terrestrial electricity accumulated in the bowels of the earth, which we know to be a reservoir of electric matter." An earthquake shock "is a direct blow not differing probably from that of a lightning stroke." "Even if it be proved that the solid strata beneath the surface and the mountain masses above it are unfavourable to the transmission of electric energy, there are plenty of cracks and fissures in its solid substances through which it may shoot forth. In the waters of ocean it finds a ready conductor, which accounts for the way in which ships on the sea are affected by it."

The attention of electrical engineers is invited to consider whether it may not be possible to invent some species of apparatus "capable of averting the calamity from its habitual haunts." The reviewer hopes that men of Science intent upon the collection and storage of electric force will not neglect "that storehouse of unlimited energy already filled within the bosom of the earth," and he trusts that they may be able to devise means for preventing the fearful disasters liable to be occasioned by earthquake shocks. We have given but a brief summary of the salient points of this cogently-reasoned paper, which deals with the subject in a

very comprehensive manner, and is especially powerful in treating on the geological portion of the question.

In April, 1882, the present writer published a small work on "The Action of Lightning," completed by him in April, 1881. He was unfortunately unaware of the researches concerning the association of electricity and earthquakes made by the authors he has mentioned, or the short allusions made to the subject in his work would probably have been more copious and decided. He ventures, however, to re-submit these few references as being perhaps entitled, in their measure, to take part as links in the chain of literary effort under investigation. The passages are as follows :—

"We appear to have *primâ facie* grounds for believing that the earth's surface is really the collecting plate of the terrestrial condenser; . . . but the questions now arise, what is the original source of the earth's electricity? and how does its surface collect it? In our present state of knowledge it seems to be impossible to get beyond conjecture in replying to such questions. Supposing, however, that we take up the opposite view, that the clouds form the collecting plate, the task of attempting to prove how they originate and collect their electricity would appear to be even more hopeless; for although we reasonably infer that the clouds are collectors of electricity, we do not know the fact for certain. . . . But we do know with certainty several important facts regarding the earth's electrical constitution; one is that it is a great holder of electricity; . . . another, that terrestrial disturbances, such as waterspouts, earthquakes, and volcanic eruptions, are connected with the actions of electricity or magnetism." . . . "As to how the earth . . . became a magnet we are practically in total ignorance. The fact, however, that it is *simultaneously both a holder of electricity and a magnet* is well worthy of attention; and so also is the fact that phenomena undoubtedly electrical, *i.e.*, earth-currents and auroræ, are invariably accompanied by magnetic disturbances." . . . "May we not conceive the subtle force usually called magnetism to be nothing but electricity, *i.e.*, *electricity bound or manifested in a peculiar manner*, and magnetism itself as only a *property* or influence . . . appertaining to certain bodies and permitting this particular manifestation?" . . . "On this principle, then, the earth is a magnetic body like steel or iron, and what is known as its magnetism becomes an additional proof of the presence and activity of its *electricity*, and strengthens the probability that the globe is itself the *originator of thunderstorms and of all other electrical phenomena*

*known to occur in connection with it.* That the separated agencies composing this electricity should be in constant motion in the magnetic field or orb from the Equator towards the Poles is what is to be expected; . . . hence . . . we have manifestations of motion (rendered irregular by induction and by geological causes) in the shape of *earth-currents.* The polar accumulations of electricity . . . would explain the *attraction of the earth's poles* on those of other magnets. To the same fact of dense accumulation of electricity at or near the magnetic and terrestrial poles . . . would be attributed the manifestations of silent continuous discharges . . . seen under the form of *auroræ.* And it is conceivable that the electricities, in their motions . . . towards the poles, are occasionally forced . . . to accumulate for a time at certain places on the surface; and when this should occur in regions where clouds . . . were frequently present, the necessary conditions for the development of *thunderstorms* would apparently be obtained. Lastly, if the . . . accumulations should occur in certain portions of the earth's crust . . . insulated from each other, and below though not far removed from the surface, and especially in regions where clouds . . . were habitually absent (as in Chili and Lower Peru), there would appear to be possible causes for the occurrence of earth explosions manifested by *earthquakes*" (pp. 156—160). In regard to the term *explosion* here used the writer is now inclined to consider the nature of an earthquake discharge as an *electrical leak* rather than as an electrical explosion.

In the "Athenæum" of July 8th, 1882, a review of the last-mentioned work was given. The reviewer noticed the portions relative to terrestrial electricity in the following terms:—"The earth-sprung lightnings which so constantly form an attendant phenomenon on volcanic eruptions, and the subterranean thunder which at times resembles the artillery fire of a naval engagement, are at once facts that support the view given in this book of the functions of the terrestrial condenser, and hints that the diligent pursuit of the enquiry may yield much valuable information as to the general theory of electric storms, aërial, super-terrestrial, or sub-terrestrial." . . . "It is from the co-ordination of the indications given by the barometer, the seismometer, and the various appliances for measuring electric and magnetic force and direction, that we must hope to arrive in due time at the true theory of electric storms, of which we take thunder and lightning to be one form and earthquake another."

The last extract in our series is one from an article on "The City of Earthquakes," in the "Atlantic Monthly Magazine" for March, 1883, by Mr. Horace D. Warner, a Civil Engineer who was present at Caracas during the last earthquake there, on September 6th, 1882. It appears that it was accompanied by a coast wave, and that serious damage was almost wholly confined to the river suburb, the higher portions of the town, built on a rocky substratum, being untouched. He says that "a native of Venezuela would laugh at the idea that a *terremoto* is an upheaval of the ground. The movement of dislodged rocks, the disjointment of house-walls and their way of falling, the motions of a tidal wave during the progress of an earthquake, all prove that the shock is a lateral push." This statement seems to corroborate the idea already suggested, in reference to the writings of Mr. William Nicholson in 1787, that the shock is probably a discharge not of the concentrated nature of an explosion, but rather that due to a *sudden escape of accumulated force from the ground over an area of some extent*,—a theory to which the facts attendant on electrical leak discharges are eminently favourable.

In order to strengthen the idea of the electrical origin of earthquakes we will now submit a list of some of those events the records of which show that they were preceded, accompanied, or followed, by storms of thunder and lightning. The incidents, unless otherwise annotated, are selected from Mallet's Reports.

*Preceded by Thunderstorms* (6 cases).

1728. August 3. Berne.
1784. April 1. Calabria.
1799. December 11. Silesia.
1828. Jan. 16. Hungary.
1830. June 26. Honan, China.
1881. July 22. Morges, Switzerland. (Standard, July 23, 1881.)

*Accompanied by Thunderstorms* (45 cases).

1606 (B.C.). Mount Sinai.
365 (A.D.). July 21. Greece and Asia Minor.
557. Constantinople and Antioch.
855. Mayence.
1062. Switzerland.
1091. Angers.
1117. Jan. Upper Italy.
1117. May. Liège.
1138. Wurzburg.
1274. England.
1365. Bologna.
1530. Flanders.
1560. Dec. 13. Vienna.
1563. Belgium.

1578. Ofen, Hungary.
1583. Mans, France.
1697. March. Transylvania.
1704. Nov. 4. Switzerland.
1711. May 17. Bergen-op-Zoom.
1715. June 12. Saxony.
1719. March 6. Champagne, France.
1720. June 1. Freiberg.
1737. May 17, 18, and 21. Suabia.
1752. Sept. 9. Rampiz on the Oder.
1765. July 23. West Bothnia, Sweden.
1778. Nov. 18. Trieste.
1784. Jan. 17. La Rochelle, France.
1786. Dec. 25. Rimini, Italy.
1791. Dec. 2. Zante.
1792. Feb. 13. Norway.
1799. Feb. 21. Frankfort-on-the-Maine.
1799. Nov. 4. Cumana, S. America.
1808. April 11 and 21. Piedmont.
1813. Sept. 22. Lower Engadine.
1813. December. Epirus.
1821. October 22. Comrie, Perthshire.
1829. July 24. Murcia, Spain.
1837. Aug. 9. Mexico.
1838. Feb. 28. Lisbon.
1819. June 16. Masulipatam, India. (Brit. Assoc. Rep., 1855, p. 98.)
1693. January 11. Catania. (Phil. Trans. Hutt. Abr., iii., p. 556.)
1819. Jan. 28. St. Ubes, Portugal. (Howard's Climate of London, ii., 435.)
1824. July 13. Christ Church, Hampshire.
1843. July 5. Penzance. (B. A. R., 1845, p. 20.)
1845. June 13. Kent. (B. A. R., 1845, p. 20.)

The year 1750—during which, on September 30th, the shock at Daventry, in Northamptonshire, occurred—was remarkable for thunder and lightning throughout England (Priestley, Hist., 356). In 1822 "an extraordinary number of violent thunderstorms, accompanied by earthquakes and simultaneous eruptions of Mount Vesuvius," occurred in France and over a great part of the Continent (Anderson on Lightning, p. 76). In July, 1829, earthquakes occurred in Hungary and in Spain, and remarkable thunderstorms in many parts of Europe (Mallet). In 1880, and again in 1883, thunderstorms and earthquakes were very prevalent in many countries.

*Followed by Thunderstorms* (22 cases).

1622. March. Upper and Lower Engadine.
1626. Sept. 6. La Capitanata and Naples.
1628. Mecklenburg.
1661. March 27. The Valais, Switzerland.
1662. September. Rome.

1680. July 24. Orbes, Switzerland.
1750. June 24. Munich.
1752. April 15. Stavanger, Norway.
1754. Sept. 6. Constantinople.
1760. Aug. 17. Salonica.
1769. Nov. 18. Avignon.
1814. March 8. Nantes.
1821. Oct. 24. Sienna.
1823. March 5. Palermo.
1824. July 18. Gotha.
1824. Sept. 7. Guadaloupe.
1828. April 11. Venice.
1834. October 6. Cartagena, Spain.
1785. July 19. Coldstream, Berwickshire. (Phil. Tr., lxxvii.)
1864. August 21. Lewes, Sussex. (B. A. R., 1864, Trans., 16.)
1810. Nov. 29. H.M.S. *Salsette*, 10 leagues S. of Cape Matapan, Mediterranean Sea. (Edin. Journ. Sc., 1826, v., 222.)
1883. July 28. Ischia, Bay of Naples. A violent thunderstorm at Naples on July 29th. (Times, July 31, 1883.)

To the above lists it may perhaps be interesting to add a few meteorological statistics, gathered from the records of earthquake incidents, collected by the writer for analysis, up to the present date. Most of the manifestations named are probably closely connected with the action of terrestrial electricity. It is to be understood that either shortly before, or during, or shortly after the occurrence of shocks, these additional phenomena were among the attendant circumstances. The number of separate earthquake cases from which they are gleaned amounts to 490.

| | No. of cases. |
|---|---|
| Thunder, detonations, and rumblings ... | 156 |
| Isolated rushes or currents of wind, or hissing sounds, giving the idea of an escape of force ... ... ... ... | 31 |
| Waves or commotions of the sea ... ... | 28 |
| Auroræ ... ... ... ... ... | 23 |
| Meteors ... ... ... ... ... | 73 |
| Ignes fatui ... ... ... ... ... | 2 |
| Lightning flashes in the atmosphere (exclusive of thunderstorms) ... ... | 15 |
| Flames seen to issue from fissures ... | 10 |
| Magnetic disturbances ... ... ... | 22 |
| Tempests, hail, and rain (exclusive of thunderstorms ... ... ... ... | 62 |
| Whirlwinds ... ... ... ... ... | 7 |
| Snowstorms ... ... ... ... ... | 8 |

We propose to conclude our paper with a few remarks on the subject of the prevention of earthquakes. The time seems to have arrived when it behoves philosophers and physicists to devote their energies in a far greater degree than has hitherto been the case to the endeavour to prevent the occurrence of dangerous physical phenomena. The scientific tendency of the time has hitherto been principally to record and to measure the effects of these catastrophes. But it appears quite within the bounds of possibility for learned men, carried away by an abstract love of their knowledge, to push their efforts in this direction a little too far. Ingenious instruments have been devised not only for the purpose of foretelling the approach of earthquakes, but also with the object of accurately measuring their intensity, rate of transit, and other (by no means unimportant) features of their operation. But *cui bono* these elaborate contrivances so far as tending to mitigate the terrible power of the convulsions? Without wishing to undervalue in the smallest degree the great labours and researches of Prof. Palmieri, the Italian physicist who superintends the well-fitted observatory at Mount Vesuvius, designed to give warning of coming earthquakes in the region of the Bay of Naples, can it be said that a single human life, or even a single building, has been saved from loss by earthquake since its establishment? Within a space of little more than two years Ischia has experienced two severe earthquakes. By the first—that of March 5th, 1881—it appears that 114 lives were lost, 289 houses were destroyed, 260 families were rendered homeless, and property was ruined amounting in value to about £40,000. By the second—that of July 28th, 1883—1990 lives have been lost, 374 persons have been injured, and four towns and villages have been practically reduced to heaps of stone. Now it is distinctly recorded in a trustworthy source of information ("Nature," August 9, 1883) that Prof. Palmieri's delicate seismometers at Vesuvius recorded no tremors whatever previous to the fatal shock of last July. But did they even record any warning signs previous to that of March, 1881? Or, if they did, was the record of the slightest benefit?

Take another aspect of the question. By simply referring to the various illustrated periodicals of March, 1881, we see, with considerable accuracy, the nature of the buildings which by their toppling over were the immediate cause of the great loss of life that ensued. They are evidently substantial masonry edifices, ranging to as many as three and four storeys in height. Now the construction of such houses

in a place like Ischia, known to be liable to shocks, seems of itself to demonstrate a remarkable absence of reasoning power. But who would credit that after the catastrophe of March, 1881, not only were the untouched masonry buildings not pulled down or not disused, but the ruined buildings were actually rebuilt in their previous lofty fashion? But this is what has really taken place: the lessons taught by the March slaughter have been positively *nil*. One would have thought that after that event the least the Italian philosophers could have done would have been to insist on all buildings in Ischia being constructed of wood (or of light iron), and only of one storey. But they appear to have neglected their obvious duty in this respect; the Public Works authorities seem to have displayed to an abnormal extent the *laissez aller* qualities proverbially attributed to the denizens of Southern Europe, and the result has been the great human sacrifice that has recently taken place. But if the theory of the electrical origin of earthquakes cannot be proved to be the delusion of madmen, do not these successive Italian holocausts call for at least a careful examination, by bodies of men like the Academy of France or the Royal Society of England, of the facts and arguments brought forward by those who earnestly advocate this theory? Take the matter on this ground alone. If the electrical theory be accepted there is at least a *chance* of devising measures capable of tending to avert these disasters. After much reflection the writer is firmly convinced that simple and economical means could at once be tried which might (if experiments were patiently pursued) lead to the discovery of actual preventives to these dreadful plagues. But if the theories of steam, cooling, shrinking, subsidence, vibration, &c., be persistently believed in, what possible remedy ever *can* be obtained. From their very nature these theories cannot lead to any preventive measures ever being adopted. That, of all countries in the world, the one which contains the great Calabrian "earthquake battle-field,"—the one which from time immemorial has, owing to her soil's fearful shudderings, lost unnumbered sons and daughters, prematurely cut off from this bright earth in all their youth and pride,—the one which brought forth Galvani, Volta, and Beccaria, and made her colleges the very homes and nurseries of electricity,—that this country should neglect to apply electrical experiments towards the prevention of disasters, which all experience shows are at least intimately associated with known electrical phenomena, seems almost incredible. Let us cease to stigmatise earthquakes as

"mindless accidents of Nature"; rather let us consider them as wilful strokes of the Adversary, and let us ask for light wherewith to design measures that shall tend to render these deadly convulsions impossible.

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## II. CANINE INTELLIGENCE.

(Concluded from vol. v., p. 738.)

### II.

NO one can have watched the ordinary life of dogs without observing for himself that much of their conduct is not merely the result of habit inherited or acquired, but is intelligent, original, and suited to the occasion. This is of course especially marked in specially clever dogs, but all dogs show it in a high degree. The other day I got over a fence which my dog could not get through; he immediately showed his intelligence by running along the fence for 60 yards or so, and finding out a place where he could scramble through. The *unintelligent* action would have been to jump at the impossible place for an hour or two. Not to attempt the clearly impossible is a marked sign of intelligence in dogs and men. "Happy they," says Goethe, "who soon detect the chasm that lies between their wishes and their powers."

It is not my intention, however, to give in this paper any special anecdotes illustrative of Canine Intelligence. To my mind the ordinary every-day intelligence of the dog is sufficiently convincing. When Pincher does not wait at the window for his master's return because he went out with a hand-bag, and therefore has gone to town for the night; when Sambo whines and is miserable because he sees my packed portmanteau in the hall, and knows that means some days absence; when Toby does not attempt to follow me because I have on a black hat and frock-coat; when Turk, anxious to be up to mischief, shams sleep, and then steals softly out of the room;—when ordinary commonplace dogs perform actions like these, and continually *modify their*

*conduct according to circumstances*, we cannot but call their actions intelligent.

Nor have I space to enter upon the emotional character of the dog. This, too, I must leave the reader to fill in from his own observation. What I wish to do now is to enquire whether we may apply the term *rational* to the actions of the dog? May we speak of Reason in the lower animals? Or must we speak of intelligence only, or intellect, and hold that man is the only rational creature? That, I think, depends entirely upon our definition of Reason. The word Reason is used in a wider and in a narrower sense. In the wider sense it is antithetical to Instinct; in the narrower, it is the process of abstract thought effected through the medium of signs written or spoken. If we accept the former, and regard a rational act as one performed *in special adaptation to special circumstances*, I do not see how the term rational can be denied to such acts as we see daily performed by dogs of very average ability. If we maintain the latter view, and hold that Reason is *abstract thought carried on by means of language*, I do not see how the term rational can be applied to any animal act whatever.

The question, however, arises how far we have any right to restrict the word Reason in this way? All processes of thought are carried on by association of ideas; and in the chain of association there may be links of all kinds furnished by all the senses we possess. Man adds to the natural links in this chain of association certain arbitrary symbols of his own manufacture; and we call these arbitrary symbols *words*. But does the introduction of these special links in the chain cause the association to differ in kind from that in which such links are absent? If it does, then we may fairly apply the term reason to this special form of mental action, and hold that reason is distinctive of man. But if *the nature of the association does not differ in kind*, then let us not deny to Diamond his share in the rational faculty which gave to his master his proud pre-eminence.

In this connection it is impossible to avoid some allusion to the question how far animals have the power of forming abstract ideas. Let us first hear what Mr. Romanes, a recognised authority, writes. "Give a cat or dog," he says, "some kind of meat or cake which the animal has never before met with, and the careful examination which the morsel undergoes before it is consigned to the mouth proves that the animal has properly abstract ideas of sweet, bitter, hot, nauseous, or, in general, good for eating and bad for eating,—*i.e.*, abstract ideas of quality as apart from the object

examined,—the motive of the examination clearly being to ascertain which general idea of quality is appropriate to the particular object examined." With this statement I cannot altogether agree. In the first place I do not like the use of the expressions "abstract ideas of quality" and "general ideas of quality" as synonymous; and, in the second place, if, as the words "apart from the object examined" seem to imply, Mr. Romanes wishes us to understand abstract ideas in what I regard as the true sense of this phrase, then I cannot agree that "the animal has properly abstract ideas." I do, most certainly, believe that the dog has the power of forming general ideas; but I do not believe that the dog, or any animal, has the power of forming abstract ideas properly so called.

Let me, however, show the sense in which I understand the terms general ideas and abstract ideas. I believe it to be the sense in which they are always used by Mr. Herbert Spencer. What we chiefly need now in our discussions of matters connected with this subject is greater precision in our use of such terms as these.

A general idea then is, as the word implies, opposed to that special idea which arises in the mind on sight of a particular object. If I look out of window I see a horse, and I have a special idea of this particular individual horse. (I use the word idea in each case merely to mark the opposition.) But you, my reader, who do not see that horse, have a general idea of horse called up in your mind by a certain printed word.

Now there can, I think, be little doubt that animals are perfectly well able to form general ideas of objects. See how a dog starts at the sound of a strange footstep. Surely we must suppose that the unusual footfall suggests the idea of a stranger by whom it is produced. But if of a stranger it must be general, not individual. So, too, with qualities. A strange piece of meat suggests an idea of taste, *as part of the total idea of the object;* and since the meat is of unknown and untried character, the suggested idea of taste must be general, and not particular. In this way the dog may be supposed to have general "ideas of sweet, bitter, hot, nauseous, and, in general, good for eating and bad for eating." But they are general ideas, not abstract.

What, then, are abstract ideas? Abstract ideas are ideas of qualities or relations isolated from their usual accompaniments. *The act of abstraction is the act of separating in thought qualities or relations which are inseparable in fact.* Thus we can form an abstract idea of roundness apart from any

objects which are round; we can form (and formulate) abstract ideas of numerical relations apart from the objects which enter into these relations, and we can frame and discuss abstract ideas of figure apart from the objects which exhibit this spatial relation. These abstract ideas may, moreover, like our ideas of objects (groups of qualities in natural combination), be either particular or general. The abstract idea of roundness, for example, is and must always be particular, for there are not different kinds of roundness which may give rise to a general idea of roundness. The abstract idea of a triangle, on the other hand, may be either particular, as in the case of an isosceles triangle, or general; the general abstract idea being a conception of that general relation to each other of three straight lines, without which no triangular figure can exist.

Note now the difference between the general ideas of sweet, bitter, &c., to which Mr. Romanes alludes, and the abstract ideas of sweetness, bitterness, and so forth. The ideas of sweet, bitter, &c., formed by a dog *are not isolated*: they form part and parcel of the conception of the object under examination. They are general because no special form of sweetness, bitterness, &c., can be called up in association with the other qualities of a hitherto unexplored object. But they are not "apart from the object examined." There is no separation in thought of the qualities of the object in question.

This separation, which I hold to be essential to an abstract idea properly so called, is, to quote the words of John Locke, "an excellency which the faculties of brutes do by no means attain to." It is only the human mind, and that mind in a somewhat advanced state, that can analyse an object (or group of qualities in natural combination) into its component parts, and then consider certain of those qualities to the exclusion of the others.

Man in fact does two things which no dog can do. By analysis he breaks up his conception of an object into separate components, and studies those components by themselves; and by synthesis he builds up a more comprehensive conception, adding fresh components which he has discovered by study and reflection. It is by the symbolic use of words that he is enabled to carry on his analysis; and, on the other hand, as I have said elsewhere, "it is the *word* that groups around itself not only the little cluster of associated ideas which make up the ordinary unreflecting conception of the object it symbolises, but also all those further ideas which are the result of scientific study. The word is the

peg upon which we hang those abstract qualities which by means of words we have isolated."

But it may be said that, although their language differs from ours, animals, too, have their language,—imperfect it is true, but still a language of their own,—a means of communication with their fellows; and this is perfectly true. It is true, too, that my dogs can understand much that I say to them—can understand *my* language. But all that a dog can communicate to his fellow—all that I can communicate to my dog—is a sign which he has learnt to associate with certain feelings or with certain actions to be performed. The communication deals, too, with immediate feeling or action; its sphere is the here and the now. There can be no doubt that dogs associate with barking in certain tones special emotional states in their companions. In fact it is probable that dogs can in this way communicate to each other a wide range of states of feeling. But these states are present states, not states past or future; they are their own states, not the states of others. A dog can call his companion's attention to a worriable cat, or he may have his attention roused by my exclaiming "Cat." But no dog could tell his companion of the successful "worry" he had just enjoyed, or suggest that they should go out for a "worry" to-morrow morning. And here we come upon what seems to me the fact which raises man so immeasurably above the level of the brute. *The brute has to be contented with the experience he inherits or individually acquires. Man, through language spoken and written, profits by the experience of his fellows.* Even the most savage tribe has traditions extending back to the father's father. And the civilised man—has he not in his libraries the recorded results of many centuries of ever-widening experience and ever-deepening thought? Thus it is that language has made us men; by means of language, and language alone, has human thought become possible. This it is which has placed so enormous a gap between the mind of man and the mind of the dog. Through language each human being becomes the inheritor of the accumulated thought and experience of the whole human race; through language has the higher abstract thought become possible.

Still the question remains, How far can we comprehend the nature of canine thought? There is only one way, as it seems to me, of getting at any sort of answer to this question; and that way is, by patiently and carefully considering what is the nature of the subjects on which that thought is exercised. To get any accurate notion of our

neighbour's mental calibre we endeavour to ascertain what are the subjects to which his mental activity is devoted; and to get any accurate notion of a dog's mental calibre we must surely do the same.

All I can do here, however, is to point out one or two tolerably obvious general considerations. In the first place we must not forget that it is the primary aim of cognition to serve as a guide to action, and that conversely cognition is itself determined by action. Nor must we forget that the primary motive of action is the attainment of pleasure and the avoidance of pain. I say the primary aim and the primary motive; for with physical and intellectual development there are brought into play new principles, namely, the postponement or even suppression of action, the striving after pleasures that are remote and must be reached indirectly, and sympathetic actions performed partly for the pleasure of others. The nature of canine cognitions must therefore be determined by the nature of the self-regarding or sympathetic pleasures sought (and pains to be avoided), and by the nature of the actions which are essential to the attainment of that pleasure or avoidance of that pain.

Unfortunately, however, this conclusion, whatever may be its theoretical value, is of very little service practically, from the difficulty of its application. We may say, indeed, that the pleasures aimed at by the dog are in the main personal,—that the object of their actions is for the most part self-gratification. But even here, in civilised dogs, if one may so call them, the peculiar influence of the companionship of men has wrought a great change; so that many actions are performed by the dog for his master's sake. Nothing, indeed can be more striking than the way in which some dogs seem able to sympathise with their master's moods; and the same is true of their actions towards their canine companions. No one who has had the opportunity of watching the habits of the dog can doubt that the more refined and delicately organised individuals feel keenly for the wounds or sickness of their companions. Dr. Andrew Wilson described, in the columns of "Nature," an habitual piece of unselfishnes on the part of a mongrel dog, "who for some years before the death of an old deaf and blind companion was accustomed to proceed to his resting-place, and bark in his ears, to warn him of the presence near at hand of the milk which the mistress of the house was accustomed to place for the delectation of both." And a friend of my own tells me of a dog who went to the kitchen and begged a chop-bone for "a miserable-looking white dog,"

a perfect stranger. "On looking out into the yard," writes my friend, "the memorable cur was seen enjoying the bone, Carlo sitting straight up watching him with a look of satisfaction." While we may say, therefore, that the pleasures aimed at are in the main personal, that the object of action is for the most part self-gratification, we cannot say that the pleasure is entirely personal or that self-gratification is the only object of action.

And with regard to the other point,—the postponement of action,—How far, it may be asked, has the dog the power of working now for a result in the future? This power, we must remember, is one of the main characteristics of civilised man. Man has the gift of self-restraint. A stimulus is received which prompts to immediate action, but the action is repressed or postponed. Present pain is cheerfully borne for the good results which are to follow. In savages and young children the power of restraint is not developed; they are impulsive. Immediate result is what they look to; to wait is misery. In the brute this power of waiting is still less developed, but it is not absent. A dog with a thorn in his foot will limp up to his master to have it extracted, though he knows that the process will be painful; he bears present pain for future ease. Mr. Romanes relates an anecdote which affords a good example of postponement of action. A black retriever was asleep, or apparently asleep, in the kitchen of a certain dignitary of the church. The cook, who had just trussed a turkey for roasting, was suddenly called away. During her temporary absence "the dog carried off the turkey to the garden, deposited it in a hollow tree, and at once returned to resume his place by the fire, where he pretended to be asleep as before." Unfortunately a perfidious gardener had watched him, and brought back the turkey, so that the retriever did not enjoy the feast he had reserved for a quiet and undisturbed moment.

A dog can also bide his time, and defer action to a more convenient season. And such postponement of action is a sign of developed intelligence; for it would seem to have been the original intention of Nature, so to speak, that stimulus should at once give rise to action. This is, in all probability, always the case with creatures low down in the scale of being; but as we rise in that scale, and as a central nervous system is more fully developed, a larger and larger tract of processes, accompanied by consciousness, separates stimulus from response. And now in man, and the animals which come nearest to man in intelligence, a great body of stimuli constantly received never pass into action at all.

With regard to these we remain in a state of passive receptivity. In such cases the nervous disturbance transmitted down the afferent nerve is not passed on to the efferent nerves, but is allowed to diffuse itself in the brain; and this diffusion of disturbance among nerve centres is, I believe, the most important physical accompaniment of consciousness.

We may say then, I think, in general, that the mental activity of the dog is chiefly, but by no means entirely, occupied in personal gratification, and that the personal gratification is chiefly, but by no means entirely, immediate.

One more question I would ask and briefly answer before I conclude. Has the dog any notions of right and wrong? Of course much depends upon the exact sense in which these words are used. But I think that we shall feel disposed to give a negative answer when we remember that to perceive that an action performed was wrong is by no means a simple process; for we have mentally to compare it with an action which might have been performed, and if so performed would have been right. And yet we so frequently hear it said of the dog that "he knows he's done wrong"! When, for example, my friend coming down into his drawing-room sees Tim's guilty look, he suspects that the dog has, contrary to rule, been taking a nap on one of the chairs; and his suspicions are not a little strengthened by the unnatural warmth of the easiest arm-chair. "Ah! Tim always knows when he has done wrong," says my friend. To be exact, however, the association in Tim's mind is in all probability a direct one between a nap on that chair and master's displeasure. What Tim knows is not that he *has* done wrong, which would involve more reflection than he is capable of, but that he *will* "catch it." It is the expectation of a reproof, or something more, that gives rise to the look of "conscious guilt." In the same way I believe the look of "conscious rectitude" we often see in some dogs is due to the anticipation of a word of commendation; and in general I fancy that the association in an animal's mind is between the performance of a given act and the occurrence of certain consequences. When this association becomes definite it must, I imagine, draw after it a dislike of such actions as have been accompanied by evil consequences, and a delight in those actions which have been accompanied by pleasant consequences; and eventually this dislike or delight is transferred from his own actions to the similar actions of others. Hence the cat punishes its kitten that steals; hence the baboon punishes another that performs an act which may

result in evil consequences. At the same time I believe that the love of a faithful dog for his master is such that to disobey him in itself gives rise to a sense of dissatisfaction which comes near to the prick of conscience, and that to please him in itself gives rise to a sense of pleasure which comes near to the approval of conscience.

Pleasure to be gained, pain to be avoided: these are the North and South Poles under the influence of which the compass of conscious life, brute and human, is set. In the lower animal life the pleasure is the pleasure of the senses or the gratification of appetite. These are the only things in which the animal is *interested;* they are therefore the only things of which he has any knowledge, the only things which can afford to him motives for action. The pleasure, moreover, is almost entirely individual; *each for himself against all* being the motto of the male, *each for herself and little ones against all* being the motto of the female. In the higher animal life sympathy begins to come in, and through sympathy a much higher type of action can be evolved, so that the motto becomes *each for himself and companions against all.* In the dog his affection for man raises him at once in the scale of being; many of his actions are performed not for self alone, but for the master. *Each for himself and for his master against all* is the motto of the dog. This is a great step, introducing many actions which are not merely done in self-gratification. Not his pleasure alone, but his pleasure in combination with that of his master has to be aimed at. When we come to man at his highest we have a quite new motto: *each with all for all.* Not his own pleasure alone, but the highest pleasure, and the greatest good of the community has to be aimed at. And much of the moral warfare of man may be symbolised by a struggle between the two mottoes—*each for himself against all,* and *each for all with all.*

The community of feeling expressed by the latter motto has, I believe, been made possible by language. Community of thought and experience has brought with it community of feeling; and out of this two-sided community has grown the possibility of those forms of pleasure which are essentially human. The pleasures of the senses and of the gratification of appetite have been supplemented by far higher pleasures,—æsthetic, intellectual, and moral. Interests, sympathies, knowledge have alike been widened. The difference between the human mind at its highest and the brute mind at its highest has thus been rendered immense. Very great, too, is the difference between the human mind

at its lowest and the brute mind at its highest; and one of the most marked ways in which this difference shows itself is in the fact that through the possession of language the lower human minds can be raised. The possession of language gives to the savage a potentiality of higher things altogether beyond the reach of the brute. The question whether animal intelligence could develop into human intelligence—or rather *has* developed into human intelligence—depends therefore very largely on whether language could be, or rather has been, naturally developed. This question I am not competent to discuss; but the principles of the great hypothesis of Evolution, which account for so many of the problems of Nature, lead me to think that most probably it has been so developed.

C. LLOYD MORGAN.

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## III. THE SUN-SPOTS AND THE ZODIACAL LIGHT.

By A. H. SWINTON.

THE astronomer Cassini put on record, about the year 1683, that during the prevalence of the sun-spots the zodiacal light may be expected during the months of February and October. This spring, when turning over the leaves of the "English Mechanic," I observed a note to the effect that an enthusiastic astronomer, whose eyes had grown dim in watching, had at length noticed this singular phenomenon. At that time, as far as my recollection goes, it took the form of a pale bluish halo in the transparent air after sundown; but it would appear as if the polarisation of the mellow autumnal mists have lent to it a far greater magnificence in some parts of the world. Under date of October 26th a relative writes from the Kangra Valley, North India:—"There has been a good deal of fresh snow on the hills; it has fallen early, and there is prospect they say of a cold winter. The last two nights we have seen the curious glow—you may have read of it in the papers—in the western

sky, long after sunset. It is something like an aurora, but does not flash, and is more lurid."

The zodiacal light, however, is not only seen at sunset, for it is frequently in the East the herald of sunrise. Dr. Adam, as quoted in the "Edinburgh Cabinet Library" (vol. iii., pp. 257-8), thus describes its shadowy form:—"It was quite dark, excepting what light the stars afforded, which in India is always considerable at this season (October), when not a cloud obscures the expanded vault of the heavens. After moving on for some time, on turning my eye towards the east, I could perceive the first appearance of day. It was not dawn, but a mere greyish pillar of light shooting from the horizon upwards, in the shape of a comet's tail, but without lustre; the effulgence, if it could be so called, resembling that of the milky way more than any other object in Nature which I have seen. This dull *pillar of light* was well defined. It continued a long time apparently little increased in size, and without having acquired much brilliancy. At length its sides near the bottom gave way, and the light, now stronger, diffused itself latterly to a considerable extent." Then came the roseate hue on the clouds, a pillar of red or orange-red light, and the large and fiery sun, the nucleus of the great comet and torch of day. The writer adds—"This pillar of light is the *zodiacal light* first mentioned in modern times by Childraus in the year 1559, and again seen by Cassini on the 18th March, 1683. Cassini, Mairan, Euler, Laplace, Regnier, Hube, and Hahn have speculated with regard to its nature." So also have Kepler, Fatio Duillier, and others more recently.

Perhaps the following extract that lately appeared in the "Daily News" may tend to show that the zodiacal light is a beam of *light* proceeding from the sun, or rather the lenticular form the light given out by the sun assumes when seen through our concave atmosphere under certain conditions of dryness or humidity. "Mr. M. L. Rouse, of the Inner Temple, writes to us:—'In coming up from Maidstone to London by the Chatham and Dover Railway, on Thursday, the 9th of November, our train was nearing Sevenoaks at half-past five, when we perceived in the north-west above a black band of cloud that lay along the Knockholt Hills a bright semicircular flush of pink light, which kept its colour undimmed for fully a quarter of an hour, amid the deep azure of the surrounding heavens, spangled with stars almost to its very border. Towards its centre the pink, or red, was shaded off to yellow, and a yellow riband of light

was seen through a rift in the dark band aforesaid. A little further on the road we found that it had grown paler, the yellow tint replacing the red. The centre of this rosy film was about 50 degrees north of the point of sunset, and it spread in length over some 30 degrees, and in height above the cloud-bank 12.'" Doubts were cast upon this beautiful sight being an Aurora Borealis, and the writer would suggest that it was a form of the zodiacal light produced by atmospheric *refraction*. The fine lunar rainbows that have appeared during the past damp spring may have been remarked; one was seen near Glasgow, at moonrise, on the 24th of February, that stretched from the eastern to the western horizon; and a beautiful one was seen at about half-past eight on the 16th of April at this place, encircling the moon: the sunset had previously been remarkable, for no sooner was the luminary descended than a sheaf of rosy rays shot up like a bouquet of sky-rockets.

Guildford, November 20, 1883.

## IV. BARON NORDENSKJŒLD'S GREENLAND EXPEDITION.*

By Count O. REICHENBACH.

BARON NORDENSKJŒLD draws from his experiences some conclusions by which he renounces without necessity with the mistaken also the correct in his former expectations. My anticipations having proved right with regard to the leading questions, I beg him to reconsider his present views. I do this not from fondness for contradicting, but in the interest of a theory of the configuration of the Earth mostly contained in "On some Properties of the Earth" (London, 1880), where the passages quoted may be found on the pages here named.

The Baron said in his programme, "On the contrary, the following reflections seem to demonstrate that it is a physical impossibility that the whole of the interior of this extensive

* "Nature" of May 10th, and 1st and 8th November, 1883.

continent can be covered with ice under the climatic conditions which exist on the globe south of the 80th degree of latitude." "With regard to Greenland it is not difficult to demonstrate that the above-described conditions for the formation of glaciers do not exist," "if the country does not rise gradually both from the eastern and the western shore to the centre, and thus be like a loaf of bread in shape, and with sides slowly and symmetrically terminating in the ocean. Such a land formation is, however, not found in any part of the orography of the known world, and one may therefore safely conclude that neither is it to be found in Greenland. In fact the geological nature of Greenland, very similar to that of Scandinavia, seems to indicate a similar geographical formation, *viz.*, a formation formed of mountainous ridges alternating with deep valleys and plains; while one may even assume that the culminating line of the land in Greenland runs, as in England and Sweden, and in both American continents, along the west coast."

Having found the interior of Greenland covered with ice, Baron Nordenskjœld says—"That we found no ice-free land in the interior, or that it does not exist between 68° and 69° latitude, is due directly to the orographical conditions which exist in this part of the country, as referred to in my programme of the expedition. The *land has here* the form of a round loaf of bread, with sides gradually and symmetrically sloping down to the sea, *i.e.*, exactly the shape which I then pointed out was a necessary condition if the entire country should be covered with a continuous sheet of ice."

Page 277 I said—"The great mass of all perennial ice has grown on land. Huge glaciers, wedged between mountains and vast ice-fields of great thickness, cover the polar lands, whereas ice formed on the ocean never exceeds 33 feet." "These masses of glacier and field ice travel from higher to lower ground, and under thronging pressure over dale and hill until they fall as frozen rivers over precipitous cliffs into the sea, or enter it gliding from gentle slopes, get beyond their depth, are uplifted, split under contending pressures and temperatures, and drift as hard land ice amongst the softer ocean ice to be gradually consumed."

"For the formation of ice-fields it is only required that more water from the atmosphere should be deposited on land, at a temperature below 0° on a surface below 0° during part of the year, than the direct rays of the sun and the indirect sources of the heat can melt during the other part. When there is a considerable excess of ice formed over the

surface, a portion may move to places where there is an excess of heat, but not sufficient to consume the imported ice, which becomes perennial."

"The growth of perennial ice within the *Arctic zone*" "is almost entirely confined to the *polar land section*, Greenland, the Archipelago, and scattered islands." I distinguish between astronomical and meteorological zones; the lands belonging to the continents Asia, Europe, and America inside the polar circle are not strictly polar, whereas lands outside that circle belong to the *polar section*. "Many icebergs are destroyed within the Arctic lake and its outlets; others enter the Atlantic, and melt about the bank of Newfoundland, and between 44° and 52° W. long., &c."

"We may assume that in Greenland," "and in the more extensive islands," "the east coasts are more precipitous, with little extension up to their crests. We may infer, chiefly with regard to Greenland, that the western shore, less elevated and comparatively free from ice, sufficiently rises inland to give to the interior and its ice-fields between east and west the shape of a trough. We may consider it likely that in the north-east of Greenland, to the west of the peninsula or island chain (Part I.), reaching almost to 87° N. lat., there is about 82° 20′ lat. the mouth of a comparatively considerable river, occupying a position *similar to the Nile* in Africa, &c."

Page 278: "As the west coasts of Greenland and the islands are most free from land ice, the excess in the deposition of water must fall on the *east* and the *interior*. It must come with the reflux of the polar atmosphere, by aspiration, after the warm ocean stream has been reversed at the North of Europe and Asia, and the atmospheric currents have been partly reversed, from east to west, from the west coasts of Nova Zemlya and the west coasts of the spurs of the Ural and the Siberian peninsula, and have partly sped on overland, north to south, through Siberia and North America."

*I also* pointed out similarities of the *Arctic section*, Greenland, and the Archipelago at its west, with the sub-section of the "middle segment," Scandinavia with Finland at its east, but remarked that they are inverse in position as to west and east, the elevated borders in Greenland being placed inversely as the "Appalachians and Cordillera," the greater elevation facing the greater ocean, according to Dana's rule.

When Baron Nordenskjœld cautiously says "The country, or *more correctly the ice*, now gradually rose from 963 to

1213 metres," I, assuming that the eastern rim is highest, as those who navigated in the east confirm, and together with the western rim gives to the "interior and its ice-fields between east and west the shape of a trough," naturally meant that *the land* has the shape of a trough filled with frozen water.

Baron Nordenskjœld supposes "a formation" "not found" "in any part of the known world," merely because he believes one cannot otherwise account for the ice in the interior, being himself not aware to what extent the atmospheric and oceanic circulation, and the *sectional* character of the polar regions, differ from that of other regions.

Pages 277 to 294: I find that all perennial land ice to a great extent afloat on the sea represents a block 1018 feet thick, covering 773,000 square miles (60 sea miles to a degree) divided between north and south in proportion 1 : 4·78; but that, being in every state of growth and decay, it occupies 2,236,000 sea square miles, equal to the Arctic and Antarctic *land sections*, themselves only covered to 2·07÷3·08 of their extent by perennial ice, the remainder being on sea and 1÷20 on other lands; and that the thickness of this ice varies from incipient growth and ending decay to that of a ripe berg about 3040 feet, going out to sea.

Can such masses extending over the whole width of Greenland, having "here" the shape of a round loaf of bread, descending symmetrically with uniform declivity to the sea, unresisted by guiding embankments of solid rock, present the spectacle described? Could there exist such an unbroken smooth surface as the Lapps passed over in so short a time? Would not the whole mass, furrowed during the warm season by water above and below, expanding, splitting, move down to the ocean with increasing rapidity, leaving the incline denuded for a new gradual growth of ice?

The harbour where the Expedition landed was "surrounded by gneiss rocks from 600 to 1000 feet in height," 1018 feet being the mean elevation of all land. The first camp on the ice was 240 metres above the sea. From camp 9, at an altitude of 753 m., "on the west side of an ice-ridge, where water from a small shallow lake collected into a big river disappeared in an abyss with azure-coloured sides," the travellers had their parting look at the country to the west, and saw even the sea shining "between the lofty peaks on the coast." Does this not mean "a mountainous ridge" at the west, between camp 9 east of the fjord entering far inland and the coast line?

The drawing in "Nature" very indistinctly shows the

direction of the watercourses, springing not from land, but from melting ice, and moving in beds of ice; they seem to point south-west and north-west as if divided by a crest indicating an elevation west to east below the ice. I pointed out similarities in the outlines of the Arctic section with Africa, Greenland corresponding to Africa east of 9° W. long. Gr., and the Archipelago to Africa west of it, and the elevation might be compared to equatorial Africa.

I was and am still of opinion that southern is higher than northern Greenland; that the elevations west and east decline going north, the eastern again rising as a peninsula or island chain between 85° and 87° N. lat.; that the ice slowly travels north; that the depressions west and east inside the bordering mountains, having an elevated plateau between them, unite in the east going north, determining and following a river bed I compared to the Nile, whereas the north-west becomes a plateau widening and descending towards the north.

The ice-field at the south, occasionally eased by glacier arms over watercourses through rents of the mountain-borders in west and east, slowly proceeds north-east through the wide valley of the polar Nile, which has its dry seasons and its inundations of icebergs and lifting pushing water, the bergs moving at its mouth west of the north-eastern *peninsula* out to sea, where they are first driven north, then west, and drift decaying through the different channels of the Archipelago towards and into the Atlantic. I believe in the open sea of Dr. Kane, and in the same sea covered with old and new drift-ice as seen by the party sent out by Capt. Nares, because I believe in a periodicity and oscillation of the ice motion and drift in the Arctic as well as in the Antarctic regions (pp. 279 and 281).

As equatorial Africa has its dry and wet seasons, and the Nile its low and high water, so has Greenland its great deposition of moisture at the south and its periodic ice motion in the north-east along the eastern river-bed and depression. And as south-western Greenland outside the western mountain-range has its moist climate and its pastures, so has the north-western plateau, like that neighbouring the Nile at its west, a comparative dryness which keeps it freer from the formation of perennial ice and a scanty vegetation,—as confirmed by Dr. Kane's and Capt. Nares's experiences (p. 127), who even speak of musk oxen near their winter-quarters.

We may then assume that the bones of reindeer seen by Baron Nordenskjœld were those of stragglers from "herds"

which travelled in search of food from the north-west, over the wide high intervening ice-fields inside the western range towards the settlements and pastures in the south-west; and we may understand why "water fowl" came from the north, and the two far-exerting ravens, who, after this visit to the travellers, again returned north.

According to my theory the growth of perennial ice within the interior is greater east than west, the deposition of ice being less and the melting greater in the west. This view I find supported by the grouping of the distances travelled with the ascents, which are not only due to the elevation of the land below, but to the unknown thickness of the ice increasing towards the east.

Leaves and berries from the south-western coast were found west, but not east, of camp 9, on the snow; they had been driven before the *ascending* wind to this weather-line, east of which the fine time turned to rain, sleet, and snow.

The most rapid ascent, 19 m. to each of 5 kilos., was from camps 8 to 9, where, at an altitude of 753 m. west of an ice-ridge, the travellers saw the last of land and the sea shining through the "lofty peaks" on the coast. The ascents now varied from 9·5 m. to each of 13 kilos., to 0·7 m. for each of 10 kilos., probably a real fall of the land; and rose again to 5·05 m. to each of 17 kilos., and to 7·87 m. to each of 31·5 kilos. The altitude being now 1213 m., the ascent to 1492 m. then fell to 4·8 m. for each of 58·5 kilos., and the ascent to 1975 m., reached by the Lapps even to 3·75 m. for each of the further 122·5 kilos.

Assuming that at the altitude of the 1213 m. the thickness of the ice was 200 m., and at that of 1575 m.—where all rivulets to south-west and north-west ceased, and the waterless smooth ascent commenced—the thickness of the ice amounted to almost 1000 metres of ripe bergs, the altitude of the land at the 1200 m. would still have been 400 m. more than at the 1600 m., and the 400 m. farther ascent on the smooth ice might signify a high plateau between depressions west and east, directed south to north, and uniting farther north-east to the bed of the polar Nile.

The ascent could not be detected by the eye "on that ice horizon which was everywhere as level as that of the sea," or by the greater exertion in ascending, "so that it was impossible to decide whether we walked up or down hill, and this formed a constant source of discussion between us, which could only be decided by the heaviness of the sledges in the harness,"—a very unsafe standard, because depending on the smoothness of the surface and the fatigue of the parties.

The guarantee for the altitudes is, then, the barometer alone, and the following sentence is perhaps worth considering, because not written on purely theoretical grounds:—Already in 1880 (p. 292) "great deposition of perennial ice on land increases the temperature of neighbouring vapour to be absorbed by the sea, and favours the absorption of the heavy gases; it *lowers barometric pressure*." If this be right the altitudes would be liable to being overrated increasingly, proceeding inland on polar ice increasing in thickness; principally in certain seasons and in comparison with barometric pressure or the neighbouring polar sea, where the pressure is relatively increased by absorption of vapour, the whole relation in these regions being thus to a certain degree out of comparison with the similar relation in other regions where experience was acquired.

## V. THE POTASSIUM NITRITE OUTCRY.

IN days of old scientific discoverers often found it needful, or at least prudent, to record their observations and conclusions in language not too readily intelligible to the outside world. Sometimes a fact was veiled in the form of an anagram. Sometimes a theory was presented as if in joke, or was followed up by a sham refutation, so that it became difficult to prove what were the real opinions of the author. The reason why truth, or endeavours after truth, had to be thus carefully veiled was, as most of our readers are aware, the jealousy of the Church. But what few of us duly consider is that—as far as one of the most important of the Sciences is concerned—we are fast drifting into a position which will render similar precautions necessary in our *quasi*-enlightened times. Just as a couple of centuries ago there were men who studied the transactions of academies and the writings of individual *savants* merely in the hope of detecting some new heresy, so at the present day the New Inquisition is unceasingly at work. Its familiars carefully examine all physiological, and especially all medical, works and journals,—not for instruction, not for criticism, but in the hope of finding something which, by the

aid of a little judicious distortion and misunderstanding, may be construed as cruelty. An eminent medical contemporary says :—" So long as lay readers indulge that morbid curiosity which leads them to peruse the pages of medical journals, it is certain that scares innumerable will be created." With all due deference we would suggest that the motive for such perusal is stronger than mere morbid curiosity. The paid official, if seized with a fit of truthfulness, might exclaim—" Sirs, ye know that by this craft we have our wealth ! " The honorary official, if candid enough, might admit that his esoteric motive is *kudos*, self-advertisement, and, in an indirect manner, advantages of a more tangible nature. Small likelihood, therefore, that such persons will desist from their search for something about which an outcry may be raised and the public deluded. Such are the tactics of all agitators, the " Humanaster " not excluded. The case then stands as follows :—In place of the Holy Office we have certain self-constituted societies ; in lieu of " Domini Canes " and the other mendicant orders we have a crowd of novelists of both sexes, who certainly have not taken the monastic vows. Lastly, certain ethicist writers undertake the task of a Caccini or a Scioppius. By the machinations of these men and women, peers, prelates, judges, and Royalty itself, have been deluded into a league against Science.

These reflections are naturally suggested by certain recent doings and sayings. Drs. Ringer and Murrell, it appears, have tried the effects of sodium nitrite in the treatment of some diseases, and have communicated the results—unsatisfactory, if not alarming—to the world in the columns of the " Lancet." What were their motives for administering this salt we—not being a medical practitioner—cannot profess to explain ; but in ordinary candour we feel bound to assume that their previous experiments upon cats must have given them reason to expect that in certain cases it might prove of value.

Their conduct in making and publishing these experiments has been severely criticised by the " Medical Times " as " a deplorably false move, which the ever-watchful opponents of vivisection will not be slow to profit by."

It has been very justly contended that one of the results of the " Vivisection Act " will be to render experimentation upon human beings more frequent ; but in this case no such plea can be admitted, since two cats had been previously experimented upon, and that with rapidly fatal effects. The " Medical Times," indeed, holds that it is impossible to

acquit Drs. Ringer and Murrell of grave indiscretion. On the principle of the trapper who seeks to secure himself against a prairie-fire by raising a back fire, it adds :—"It is with the view, if possible, of forestalling the outcry of the Anti-Vivisectionists and counteracting the effects of this terribly false step, that we have felt ourselves compelled reluctantly to enter this protest against it."

The "Medical Press and Circular" takes a more dispassionate and judicial view. It holds that "to educated medical men there can be no question either of the value of the observations detailed or of the *bona fides* of the intention with which they were carried out." It adds that "the aim of the authors was to extend the limits of our therapeutic resources by laying before the profession an account of the action exerted upon the human system by a certain drug, and every addition to the agents with which the physician is enabled to combat disease is so far a distinct gain to humanity that the most complete reports in this regard are in the highest degree valuable and acceptable." It adds, very justly, "If it should chance that we have in it a means of combatting certain affections with success, then to omit the measures necessary for proving in what manner and proportions it requires to be administered would be to criminally neglect the imperative duty of Medicine towards humanity. Until Nature's fertile resources against illness are completely explored, and each secret she can yield to therapeutics is laid bare to the hands of every practitioner, the search after new remedies must perforce be continued if we would not be diverted from the path of conquest over sickness."

Unfortunately the discussion has not been confined to professional organs. A Mr. Ernest Bell, M.A., writes to the "Standard" on the question, making large quotations from the original paper of Drs. Ringer and Murrell, bringing grave charges against hospital physicians, and displaying—if we misunderstand him not—an intense hostility against the organic sciences. Who this Mr. Bell, M.A., may be we are utterly ignorant. We do not know that he is a member of any of the Bestiarian societies; but he sufficiently characterises himself when he speaks of a "mania for testing everything and anything on all sorts of animals." Without we test "everything and anything" we must remain in ignorance about animals no less than about plants or inorganic matter. To this "mania" we owe our physics and our chemistry. If animals are to be exempted from research, the organic sciences, with their practical applications, can never be fully constituted.

It is sickening to see Bestiarians ready and willing to inflict inconvenience, pain, or death on "all sorts of animals" for any purpose save the acquirement of knowledge. May we not legitimately infer that a love for ignorance is with them more powerful than the reluctance to give pain to sentient beings?

As regards Mr. Bell's insinuation that hospital physicians intentionally abuse the opportunities of their position to make experimental studies upon their patients, we regard it as utterly unfounded, and we think it deplorable that any person with the slightest pretensions to culture should entertain, and what is worse, should seek to promulgate, so baseless a notion. We are glad to find that the "Standard," whilst considering Drs. Ringer and Murrell open to the charge of indiscretion, is yet very far from endorsing the charges brought by its correspondent. This is merely what might have been expected from its honourable antecedents. Every scientific man must remember that its conduct anent the Bestiarian hubbub has formed a refreshing contrast to the position taken by two of its daily, and still more by one of its weekly, contemporaries.

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## VI. ON THE HYBRIDISATION OF AMPHIBIANS AND THE PRINCIPLES OF REPRODUCTION.

AN extended series of experiments on the hybridisation of certain varieties and species of frogs and toads has been conducted by Professor E. Pflüger. The results, which have just been made public, are of the highest scientific importance, and merit the careful attention of naturalists.

The author establishes, in the first place, that those differences which determine the character of a race by no means compromise fertility. As regards the species experimented upon it appears that the large Berlin lake-frog and the blue frogs of the Rhine are not species, but merely varieties of *Rana esculenta*. On the other hand, *R. arvalis* (s. *oxyrhinus*) is not a variety of *R. fusca*, the brown grass-frog, but a distinct species.

As regards hybridisation the results obtained may be laid down in the following proportions :—

1. Pflüger and W. J. Smith have obtained three living frogs sprung on the mother's side from *R. arvalis*, the father being *R. fusca*. Herr Born has been much more widely successful in this respect, and has obtained many such specimens.
2. Perfectly vital semen and perfectly vital ova, capable of giving rise to perfect normal ova, possess only for a brief time the power of producing hybrids. This stage is that of the most intense heat. After it is past the ova still react normally with the semen of their own species. This fact demonstrates that the unfecundated germ and the sperm-cells before fecundation are subject to continuous internal change.

This rule holds good most sharply and distinctly for the ova, whilst the sperm is still capable of effecting a hybridised fecundation for some time before and after the most intense stage of heat.

3. Herr Pflüger succeeds in demonstrating that hybrid fecundation can be perfectly reciprocal. The sperm of *R. esculenta* fecundates the ova of *R. arvalis* as energetically as the sperm of *R. arvalis* fertilises the ova of *R. esculenta*.
4. More generally, however, hybridisation is one-sided. The sperm of *R. fusca* fecundates energetically the ova of *R. esculenta*, but the sperm of the latter has no action upon the ova of the former. The sperm of *R. fusca* does not fecundate the ova of the *Triton* (newt), whilst the sperm of the latter fertilises the ova of *R. fusca*.

This one-sidedness, if we may so call it, Prof. Pflüger explains by means of the following facts :—

*a*. Those spermatozoa are most capable of effecting hybrid fecundation which have their anterior part thin and pointed.
*b*. The ova of species whose spermatozoa have a thick anterior extremity are most liable to hybrid fecundation.

We have thus a simple mechanical explanation of the one-sidedness of hybridisation, the micropyle being exactly wide enough to allow the spermatozoa of the same species to penetrate into the interior of the ovum.

The following actual observations agree readily with the above hypothesis:—The spermatozoa of *R. fusca* have, among all Amphibians, the thinnest anterior extremity, which terminates in a sharp point; in consequence they fecundate almost all ova upon which they are allowed to act, such as *R. arvalis*, *R. esculenta*, and *Bufo communis*. On the other hand, the thick-headed, blunt-pointed spermatozoa of *R. arvalis* and *R. esculenta* cannot penetrate into the ovum of *R. fusca*. The spermatozoon of *Bufo communis*, which has a thick head but a very sharp point, in some rare cases fecundates the ova of *R. fusca*. The spermatozoa of the tritons, having pointed heads, can also fertilise the ova of *R. fusca*. On the other hand, the thick-headed and blunt spermatozoa of *R. arvalis* and *R. esculenta* cannot fecundate any strange ovum, whilst reciprocal hybridisation between the two species is easy.

In like harmony with the hypothesis the ova of *R. esculenta* are in the highest degree susceptible to the action of alien spermatozoa. They can be fecundated not alone by the male element of the frogs *R. fusca* and *R. arvalis*, but by that of the toads *Bufo vulgaris* and *B. variabilis*, and even *B. calamita*. The sperm of the tree frog (*Hyla arborea*) was found also not quite inefficient.

So far, indeed, no Batrachian has been observed whose spermatozoa are less and whose ova are more adapted to hybridisation than those of *R. esculenta*.

The same is the case with *R. arvalis*, also in accordance with the same hypothesis.

Herr Pflüger points out, however, that the experiments on hybridisation instituted by M. de l'Isle, with *R. fusca* and *R. agilis*, whose spermatozoa are exactly similar in shape, gave negative results, so that here other cases must come into play.

The author's experiments with toads agree also with the same hypothesis. Thus *Bufo vulgaris*, whose spermatozoa are capable of acting upon the ova of *R. fusca*, is able to fecundate all ova which can be fertilised by *R. fusca*,—*i. e.*, *R. esculenta*, *R. avalis*, *Bufo variabilis*, and *B. calamita*. *B. variabilis*, whose spermatozoa fecundate the ova of *B. vulgaris*, should have spermatozoa of the same thickness, as is in fact the case. The same holds good for the ova of the same species; they are more susceptible to hybridisation than those of *R. fusca*, but less so than those of *R. esculenta* and *R arvalis*.

Hence it appears that an exact knowledge of the relative magnitudes of the spermatozoa of different species

is an urgent want which is not fully met by existing manuals.

In addition to the size, the shape and the penetrative power of the spermatozoa will have to be taken into consideration.

5. Hybrid fecundation leads in part to regular and in part to irregular segmentation. Very frequently there occur, in addition to the regular segmentations, irregular ones in larger or smaller numbers. According to the most recent observations we find regular segmentation in the crossing of very heterogeneous and very irregular ones, in case of nearly related species. Sometimes there appear in the same watch-glass, along with the most abnormal phenomena of segmentation which quickly lead to the destruction of the ova, perfectly normal ones, which even give rise to viable frogs. It is almost impossible to admit that among the spermatozoa of the same portion of sperm, and among the ova from the same ovary, so great varieties of constitution may exist as to explain these striking diversities. Some quite new and peculiar agency must come into play.

In order to find a key to this riddle Prof. Pflüger investigates the principles of generation as they appear from the researches of Pringsheim, Hertwig, Fol, Selenka, Schneider, Bütschli, Strassburger, Elfving, and others. From all these researches it may be deduced, as an established principle, that generation depends on the principle of the co-operation of two specific powers, the sperm-nucleus and the ovum-nucleus. From the observation of Fol, that sometimes several spermatozoa penetrate to one ovum, and that then there arises from such egg a polygastrula with several invaginations (and that several individuals may arise from ova thus fecundated), Pflüger concludes that each ovum which has hitherto been considered as a unity may give rise to several individuals, the egg, and homologically the spermatozoon, also corresponding to a plurality of individuals. The principle of dualism in generation is, however, still upheld by the view that the many germs act upon each other by twos, whilst the superfluous ones perish.

Prof. Pflüger cannot ascribe to morphological relations any part in generation. It is a physiological process depending on the specific interactions of atoms and molecules, and independent of any aggregate condition,—consequently not subject to any general morphological law. We shall

probably never find an anatomical definition for generation, as in principle none is possible.

If we consider that every point in our organism is influenced both by the spermatozoon and the ovum whence we have originated, it is plain that generation presupposes the absolute intermixture of the substance of the spermatozoon with that of the ovum. When, therefore, during the act of generation (which lasts until the two cells have become one,—*i.e.*, from the moment when the head of the spermatozoon comes in contact with the yolk to the origin of the first segmentation nucleus), the matter of the spermatozoon is molecularly mixed with that of the ovum, this can scarcely be understood save on the supposition that the generative elements are, at least at certain points of time, in a state of liquid aggregation. The true germs may easily be chemical molecules of definite constitution. The spermatozoon must evidently surrender its inherent organisation in order to become an integrating and all-present part of the new organism, and the same holds good for the ovum. Necessarily there exists a moment of internal transposition of the molecules, and doubtless in part of the atoms. During this stage of revolution there exists no organisation. Our readers may here be reminded of the suggestive fact that when the larvæ of certain Diptera pass into the state of pupæ their muscles are resolved into a uniform semi-fluid mass. During the act of generation, properly so called, we have neither cellular substance nor nucleus, but nascent protoplasm. That this view is correct in principle can scarcely be doubted, though these processes are probably not completed simultaneously in all points of the generative mixture.

The author sums up his views on this part of the subject in the following chemical, or perhaps metachemical, representation :—

The chemical work in the molecule of living animal matter possesses its highest intensity in youth, and then decreases, becoming very small in age, and being extinguished at death. The "active" molecules—those with free affinities—constantly decrease, whilst the closed molecules increase. Hence for the maintenance of life a reciprocal process must exist, for converting the closed molecules into open or active ones. The opening of the closed affinities of the germs is therefore the essence of generation.

As every chemical reaction of two molecules liberates chemical affinities, and as electricity, heat, and light do the

same, there is no difficulty in the thought that the needful opening may be effected by the action of the male germ upon the female. In order to open chemical affinities by chemical agency there are required at least two kinds of molecules, different in some respects. This is the signification of dualism in generation.

The muscle-, nerve-, and gland-molecules form their own likeness out of the nutriment. The living molecule or molecular group has the power of impressing itself upon dead molecular groups, and converting them into its own likeness whilst receiving them into its society,—*i. e.*, into the realm of the living.

Since according to this principle the male and the female germ act upon each other in generation, each will force its peculiarities upon the other. Since thus there arise two germs of approximately like nature, the question arises whether they remain two separate individuals after fecundation, since we assume the existence of many germs in the ovum and in the spermatozoon. If we admit for a moment the hypothesis of such distinctness, we can draw therefrom certain conclusions.

If we suppose that the germs derived from the spermatozoon retain, even after fecundation, a certain specific peculiarity as compared with the ovum germs, it follows that on the formation of the sexual organs in the embryo there may be evolved two kinds of germs,—derivatives of the spermatozoa and of the ova. Each organism would thus be primarily a hermaphrodite.

When both kinds of germs begin to increase they react upon the transformation of matter in the organism, and modify the composition of its fluids. It appears now that very frequently the modification of the organism determined by the vegetation of the sperm-cells interfere with the development of the ova, and conversely the growth of the ovum masses hinders the development of the sperm-cells. Thus the sex is determined according to the germs provided with the greatest vital energy. But as the male and female germs have on an average the same vital energy, males and females are produced in equal numbers.

If we assume many germs in the ovum and in the spermatozoon, the question arises what must happen if the number of each kind is unequal, and the excess consequently escapes fecundation. Such excess will generally or always perish.

So long as parthenogenesis is maintained by zoologists and botanists, and the possibility of its existence cannot be

disputed, it follows that the germs of mature ova may increase for successive generations without fecundation. The residual germs cannot therefore be at once set down as doomed to perish. These germs which escape fecundation would explain the "reversion" of hybrids, if indeed it exists in a pure state. But a pure reversion would be intelligible even without such superfluous germs, as in hybridisation fecundation often fails, so that in one and the same ovum, along with united germs, there may co-exist unpaired male and female germs.

As to the cause of the paradoxical behaviour of the eggs of *R. arvalis*, fecundated with the sperm of *R. fusca*, Prof. Pflüger refers this phenomenon to "fractionated fertilisation." According to the observations of M. Fol the spermatozoon is immediately attacked by the yolk of the ovum at the moment of contact; consequently also when only the point of the head touches the yolk, the thicker part being kept back by the narrowness of the micropyle, or by the excessive stiffness of the gelatinous matter.

We may thus imagine that the point of the head of a spermatozoon which has penetrated into the yolk, whilst the thicker portion is wedged fast, may be resolved into particles, thus producing an abnormal segmentation.

This explanation of anomalous hybrid segmentation by "fractionated fecundation" renders it intelligible why in hybrid fertilisation we can find no rules. Each egg becomes differently segmented, perhaps because the quantity of the spermatic substance differs in every case. Such anomalous segmentation is not inseparably connected with hybridism; it occurs also during the fecundation of the ova of *Bombinator igneus* with the normal sperm of its own species, if too little water is present. The gelatinous mass enveloping the ovum remains then very stiff, and it is possible that the spermatozoa may often fail to penetrate into the yolk. If the fact that the hybridisation of nearly related Batrachian forms leads sometimes to normal and at other times to the most abnormal developments may be explained as above, it is very probable that both irregular segmentation and entirely negative results in crossing the Anoura are due merely to such secondary complications. The true law is probably reciprocal fertility in all with normal segmentation, and, with few exceptions, death during the first stages of development. Whether this law extends to the hybridisation of the Anoura and the Urodela cannot be asserted.—*Pflüger's Archiv. und Naturforscher.*

## VII. DR. MELDON'S ELECTRIC MOTOR.

ELECTRICITY, both as a means of lighting and locomotion, has made, during the past few years, such vast strides in public favour, that it is not surprising many discussions have been raised concerning it, or that the minds of the leading scientists have lately become engrossed with the study of so interesting a subject. Up to the present, however, owing to the enormous amount of electricity required to work even a medium-sized dynamo, all attempts at electric propulsion, especially as regards boats, may be considered as purely experimental, its most ardent advocates being unable to claim for it any economical advantage over steam. Many theories have been adduced towards, and several electricians have applied themselves to the task of, surmounting this difficulty; but it is to the intelligence and ingenuity of an eminent Irish physician that the scientific world is now indebted for the discovery of an important principle, which will, without doubt, be recognised in future in the construction of all magneto-electric machines. To Dr. Austin Meldon, of 15, Merrion Square, Dublin, belongs the credit of having designed a motor which not only does away with the manifold disadvantages and drawbacks attendant on the employment of dynamos, but also creates the largest amount of driving power, with the least expenditure of electrical force. Dr. Meldon, in his first attempt at motor construction, made use of twelve magnets, but when the machine was tested it was found that although each of the magnets would lift half a cwt., or attract a heavy iron bar from one inch, yet the whole twelve, when bound together, would only lift or attract exactly the same weight. Seeing that something was evidently wrong he sought information as to the cause of so singular a circumstance, but although he received a very large number of suggestions, not one of his correspondents hit upon a solution. Nothing discouraged, Dr. Meldon persevered in his investigation, with the gratifying result that after some trouble he found that the inertness of the magnets was due to neutralisation, and that by magnetically insulating the bars—about to be described—with copper instead of iron bolts, and putting a few layers of gutta percha between the bars and the rims of the wheels, he could develop full power,—a fact which seems to have been hitherto unknown.

The armature of the new machine is formed by joining together two 15-inch solid pulley wheels, with seven flat bars of iron, each bar being 24 inches long by 3 inches wide, and 1½ inches thick, and, as has been observed, the bars are laid upon gutta percha, copper bolts being used to fasten them to the wheels. A shaft of 1½-inch steel passes through the centre, and the whole is supported by a hard-wood frame, stayed with iron. Each side of the frame, where the shaft emerges therefrom, is supplied with an ivory commutator, the one on the right having three, and the other four, brushes, each of which communicates with a magnet. Attached to the frame are seven electro-magnets; the three larger ones being made of 2-inch soft iron, and wound with No. 14 wire, without bobbins, and the other four of 1½ inch iron, and wound with No. 11 wire. The total weight, as at present constructed, is a little over 3 cwts. The first trial of the motor took place in July last, in a boat 22 feet long and 5 feet beam; and the battery used on the occasion consisted of thirty-six cells of bichromate of calcium, with zincs 6 by 4 inches, and carbons 6 by 5 inches, the latter, as will be observed, *being larger than the former.* Half of the cells passed through a commutator into one set of magnets (the whole charge going into one magnet at a time), and the remainder of the cells, through the other commutator, into the second set. The great utility of this arrangement was experienced during the trip, as when all the cells were made use of the boat went at full speed, but when only one commutator was employed half-speed was obtained, and on a long trip the second battery could, of course, be re-charged. The motor is capable of making about 900 revolutions a minute, but this in the trial trip was reduced to 400, when the boat went over, with a slack tide, 9 miles in a little more than one hour, a single mile having been accomplished in seven minutes, and subsequently, when the tide was more favourable, 11 miles were gone over in an hour. A little over two-horse power has been registered from only twenty-four cells; and here it may be remarked that Dr. Meldon, who takes an unusual interest in anything that relates to this science, has managed, by a very simple contrivance, to get over the difficulty hitherto experienced in keeping up a continuous light for many hours: that gentleman has had five Swan lamps in his house during the past two winters, and he makes his bichromate cells last twelve hours, by using large zincs and carbons, which at first are only immersed a short distance in the fluid, and then after two hours lowered a few inches

more, and so on, using of course a larger number of cells than is absolutely required.

It is to be regretted that, owing to the small size of the launch, the battery, which was placed in the forward portion of the boat, eighteen cells being arranged on each side, occupied so much space that there was only room left for four persons to sit with any degree of comfort, and consequently he was obliged to abandon the idea of working his motor with a battery, but, judging by the actual results obtained, he is confident that with *two* storage cells of an accumulator he could easily obtain a speed of over 11 miles an hour.

The advantages claimed for the motor over a dynamo are—1st. Only one-tenth of the battery-power is required to obtain a single horse-power. 2nd. As there is no dead centre it will start instantly, and there is therefore no loss of power. 3rd. The whole force of the battery passes into one magnet at a time, so that very little power is required. It should be remembered that the launch *Electricity* had forty-five accumulators of the latest type on board, which were calculated to supply power for six hours at the rate of four horse-power, the mean speed obtained having been 9 miles an hour. Dr. Meldon's had only thirty-six cells, and did a mile in seven minutes, and it should be noted that the battery was nearly exhausted when this trial took place.

Dr. Meldon's object in consenting to the publication of these details of his motor is twofold:—First, to place upon record an account of his original experiments for the benefit of those who are interested in the subject of electricity as a motive power; and secondly, to receive any practical suggestions which the readers of this brief description of his important invention may be disposed to send to him. The magnets were supplied by Mr. Henshaw, of Christchurch Place, Dublin; the ironwork by Messrs. Booth Brothers, of Stephen Street; and the commutators by Messrs. Curtis and Son, of Abbey Street, same city.

## ANALYSES OF BOOKS.

*Evolution and Natural Theology.* By W. F. Kirby, of the British Museum. London: W. Swan Sonnenschein and Co.

It is rarely possible for the scientific reviewer to take up a treatise dealing in any way with Evolution without a sigh of dissatisfaction. Too many such books are written by men profoundly ignorant of biology in every department, their sole preparation being, perhaps, the hasty and heedless perusal of a part of the "Origin of Species."

The work before us, we are happy to say, is one of a very different stamp. The author is well known as an industrious and successful worker in Natural History, thoroughly versed in the evidences, the bearings, and the results of the Doctrine of Organic Development. That, like almost every competent enquirer who has given the subject a fair study, he is a decided Evolutionist need not be said.

Mr. Kirby's object in the present book is to deal with one particular objection by which the religious world is still much exercised. Few of us have escaped being asked how we propose to reconcile the origin and career of plants and animals upon Darwinian—or more generally upon Evolutionist—principles, with the Mosaic cosmogony, as well as with many passages to be found elsewhere in the Jewish and Christian Scriptures? Such enquirers, if silenced for the moment, are by no means satisfied if we reply—in the language of Bruno and Galilei*—that the Scriptures were not intended to serve as a text-book of Natural Science, and that on such subjects they convey merely the ideas current in the days when they were written.

Such a work as that before us, in which the author seeks to show that the theory of Evolution is not "opposed to the principles of Christianity or the interests of true religion," will be welcome to many, and may, we hope, clear away prejudices which prevent many from giving the question a fair examination. Mr. Kirby, at the end of an opening chapter in which the ancient and modern views of Nature are contrasted, suggests that "Science and Religion may at length meet on the broad platform of Theism and Philanthropy." In this same chapter we meet with a passage not without significance as showing one remarkable tendency of modern thought:—"Nor can we for a

* See the letter of the latter to the Dowager Grand Duchess Cristina of Tuscany.

moment rationally suppose that even the highest and noblest of our race can reach the presence of the Infinite itself at one bound from a world so low as this. Rather let us acknowledge, with the Buddhists, the much greater probability that ages of progress, and possibly a great variety of stages of existence, may separate us from Nirvana."

Mr. Kirby, indeed, so far from being what is commonly styled a Materialist, makes a certain approximation to the so-called "Spiritualist" and Theosophic views. He contends for the immortality of animals as a corollary of that claimed for man, and on this subject he quotes Allan Kardec. In a note he speaks of the Resurrection of Christ as "a case of long-sustained materialisation." He accepts the doctrine of re-incarnation as at least conceivable, and combats some of the objections with which it is ordinarily encountered.

Hence the present volume will doubtless be read with interest not merely by avowed Spiritualists, but by that class—and judging from popular literature it is numerous—who have a vague yearning for evidences of an unseen world. On the other hand, this Eirenikon will fail to command the sympathies not merely of Materialists, but of orthodox religionists. We know that, in some quarters, to ascribe immortality to brutes is a deadlier sin than to deny it to man.

Turning from these generalities to a notice of particular passages, we find the author emphasizing rather more strongly than should we the modern origin and character of Physical Science. He urges that Evolution was not admitted in the days of antiquity, and judiciously remarks that "it would certainly not be a presumption in favour of Evolution that it was accepted as a truth by the ancients, but rather the contrary."

In discussing the old doctrine of Special Creation, he points out that the only view which can even partially reconcile such creation with existing facts is Gosse's theory of Prochronism, unmatched, and perhaps unmatchable, in its absurdity.

In the third chapter we find a statement which many of us will probably feel unable to accept. Says Mr. Kirby:—"The history of the earth, as a whole, furnishes no instance of a retrograde movement." Now even ignoring the Glacial epoch, a catastrophe some of whose results are probably irremediable, we can scarcely deny that a gradual refrigeration of the earth is going on, analogous to the senescence of the individual. Surely here is an element of retrogression, which, unless physicists are utterly mistaken, must sooner or later make itself felt.

On the subject of hybridism the author, as it appears to us, concedes too much to Anti-Evolutionists. He writes:—"Others supposed that new species might have been produced by the intercrossing of old ones: but this cause is now known to be physiologically almost impossible in a state of nature."

Again he says:—"The objection drawn from the physiolo-

gical difference between species and races still exists unrefuted." He adds, in comment, "This is indeed the great stumbling-block to all theories of Evolution." To us this objection seems merely an imperfect, and therefore false, generalisation." Mr. Seebohm, in his interesting work "Siberia in Asia" (*see* "Journal of Science," vol. v., p. 36), mentions the interbreeding of the carrion crow and the hoodie, which takes place on the large scale. The evidence of the fertility of these hybrids is quite conclusive. It is no less certain that the half-breeds between the American bison and the common cattle are prolific. These instances alone are sufficient to refute the objection cited.

In the chapter on Homology we find notice of one of the errors which on careful search may be found in the Duke of Aygyll's over-rated "Reign of Law." The Duke writes—"In his (man's) frame there is no aborted member. Every part is put to its highest use." Mr. Kirby, in reply, mentions the vermiform appendage in man, not only useless, but even dangerous.

Under the head Embryology we read—"We may hope that the actual length of human life will continue to increase until it ultimately reaches this limit (*i.e.*, 120 years)." So long as men and women are at a discount, as at present, increased longevity is anything but desirable, unless accompanied by other changes of which we see little immediate prospect.

In speaking of Geographical Distribution the author makes a remark which will be novel to many of his readers. He writes:—"The tropical representation of widely distributed genera are frequently inferior in size and beauty to those of temperate climates, and rarely surpass them, for the magnificent productions of the Tropics usually belong to groups entirely unrepresented in colder regions." It is noteworthy that specimens of *Chærocampa Nerii* from South Africa are less beautiful than those from Europe, the green in the former being more of an olive cast. At the same time we must remember that such widespread groups as the Buprestidæ and Cetonidæ attain their greatest size and splendour in hot climates, those of Europe, North Asia, and North America being comparatively small and dull in coloration.

The author refers the fact that the African Negro does not, like the other inferior races, tend to die out in presence of Europeans, to climate. We doubt the sufficiency of this explanation, since the Negro multiplies rapidly in the healthy regions of South Africa and in many of the States of North America, where, indeed, the possibility of his ultimate preponderance is regarded not without apprehension.

We are heartily with Mr. Kirby when he protests against Mr. Galton's "ranking Socrates and Phidias above all who have suceeded them in Europe." Phidias we cannot profess to estimate, but the working and influence of Socrates and of his school were, we hold, decidedly pernicious. He blighted the

seeds which had been sown by Democritus, and led the way to that neglect and contempt of Nature from which we are only beginning to recover.

Were we, however, to notice every passage in this work which may be considered to deserve comment we should far exceed our allotted space; but we are bound to say that Mr. Kirby has presented the evidences of Evolution in a clear and acceptable form, showing that the New Natural History stands in no necessary connection with Atheism. Hence students of religious principles need not fear examining Nature from the point of view which Darwin and Wallace have made accessible.

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*To all the Invisible Gods: concerning two distinct Bibles being composed in the one Bible.* Part First. From and written by JAMES W. FORREST, surnamed "JOHN." Comprising Special Revelations, and in reference to "Endymion." (No publisher's or printer's name.)

WE have here a work the greater part of which is devoted to scientific questions, but which is of a truly perplexing character. The author tells us in his Preface that to him there has fallen a strange, and in our age and life an unknown, position; that his writings form the only real Revelation published for eighteen hundred years. He comments on the "awe, fear, and dread which have been taught concerning the character of the true gods," and on the mystery of existence. He raises the old and painful question—"Why do not mankind find themselves in circumstances to satisfy their most natural desires and delights? What is, what was, the reason of restriction or 'holiness?'" Again, he asserts that he has received real Revelations, and adds that the consideration of these matters passes to him "from the deceased Earl of Beaconsfield, whose communications placed for my observation will be produced." Knowing that the deceased Conservative statesman was "for the angels," though too wise to commit himself to an indiscreet dabbling in Science,—as his great rival has done anent the evolution of the colour sense,—we have searched for these communications, but have not been able to find them in this "Part First."

Our author is prone to heresies, scientific as well as theological. On one and the same page he tells us that "animals were not born of the Father or formed by him, but were bred from the earth by certain changes which occurred some 6000 years ago or so." Here special creation and evolution are denied in the same breath, and a very recent origin is ascribed to the animal kingdom.

Theologians will stand aghast at finding in the next paragraph —and indeed throughout the book—Michael the Archangel identified with Satan.

Scientific dicta, or rather utterances on scientific topics, are numerous, but for the most part they are utterly contradictory to our present knowledge. Nor is there any evidence vouchsafed in proof of Mr. Forrest's conclusions. He writes:—"If anyone were to ask what nothing is, we might say that nitrogen is the nearest to it in existence. We should begin by defining its properties, or more exactly the properties it does not possess; it should have neither weight, hardness, taste, appearance, sound, smell, and no motion, therefore no colour or light, and be unclear, void. Nitrogen has no weight or action in the universe, being nothing." We need scarcely say that nitrogen has decidedly weight, and, though inert in the free state, is, when in combination, an essential constituent of foods, organic poisons, of the most beautiful colours, of many medicines and explosives.

Heat, we are told, "is a rubbing pressure, cold is a motionless pressure." Weight or gravitation is said to be "an improper state." Oxygen is pronounced a heavier body than other gases. We read further of "white motions, suns, or stars." Water is said to be "formed by a thin and invisible motion (such as hydrogen) moving in perfect space, grasping within its surface the still oxygen till it has assimilated or filled itself, and ceasing its own action, as also that of oxygen, both become water together which is clear like space."

We must confess that we are unable to reach the point of view needful for appreciating these propositions.

The writer concludes with a fascinating picture of "human life before time was."

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*Records of the Geological Survey of India.* Vol. XVI., Part 2. 1882.

THIS part contains a Synopsis of the Fossil Vertebrates of India, by R. Lydekker. The oldest known amphibian, it appears, is represented merely by a skull and a part of a vertebral column of a large species from the Gondwanas. Curiously enough this specimen was sent to England for description eighteen years ago, and has only just been recovered, having lain all the time unnoticed.

Among the reptiles there is a notice of some vertebræ from the Panjab and Sind belonging to a python, and not to be distinguished from the living *P. molurus*.

Among the tortoises is mentioned the enormous *Colossochelys*

*Atlas* from the Sub-Himalaya and Burma. This fine species is supposed to have been 22 feet in length.

Mammalian remains are numerous and important, though none have yet been detached below the Eocene.

The Pliocene furnishes the palate of a female, and the upper canine of a male belonging apparently to a large anthropoid ape, *Palæopithecus Sivalensis*. This species is distinguished from the mias of Borneo and Sumatra, to which it otherwise approximates, by the narrower form of the premolars. *Felis cristata*, otherwise known as *F. palæotigris* and *F. grandicristata*, is a large tiger, distinguished by its greatly developed sagittal crest. To *Machairodus* (why, in accordance with all analogy, is this species not named *Machairodon ?*) belongs *M. Sivalensis*, ranging in size between the tiger and the jaguar.

All the known genera or sub-genera of the Proboscideans are represented.

The rhinoceroses—one-horned, two-horned, and hornless—are also well represented. Some remains, now in the author's hands, seem to approximate to the existing African species. The remains of rodents are few, and there is only one edentate, *Manis Sindiensis*, a pangolin four times the size of the still living *M. pentadactylus*.

Altogether a Pliocene fauna is characterised by the admixture of genera now peculiar to Africa, and of Miocene and Pliocene Europe with the forms now especially Asiatic. "Modern India has only the impoverished remains of a once extensive fauna of mighty forms." The high degree of specialisation of many of the genera is a marked feature.

The author adds, in conclusion, a very valuable chronological list of species.

Mr. F. R. Mallet, F.G.S., furnishes a paper on the "Iron Ores and Subsidiary Materials for the Manufacture of Iron in the Jabalpur District." The author recommends Murwara as a site for iron-works.

Mr. Mallet also contributes a paper on the "Lateritic and other Manganese Ores found at Gosulpur, in the Jubalpur District.

Mr. T. W. H. Hughes writes on the Umaria Coal-field, and recommends practical trial.

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*The English Illustrated Magazine.* No. 3. December, 1883. London: Macmillan and Co.

THERE is little matter in this issue which can legitimately come under our notice.

"Corn-cockles" is a botanical paper of a kind with which the public are by this time very familiar, and certainly does not require the author's signature.

The "Story of a Courtship" literally swarms with dogs, like a side street in Constantinople. The constant presence of these obtrusive and mal-odorous animals in modern fiction is no pleasant symptom.

The "New Hero," amidst some apposite denunciation of cram and modern education, indulges in certain gratuitous sneers at Science. "Nor did the biologists (Frankenstein alone excepted) ever make a man." Why should they? Man is already, such as he is, a drug in the market! "What the age wants is facts." Yet the crammed child is dosed daily and abundantly, not with facts, but with fiction,—at best is fed upon words in place of things.

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*Association for the Improvement of Geometrical Teaching. The Elements of Plane Geometry.* Part I. (corresponding to Euclid, Books I. and II.). Prepared by the Committee appointed by the Association. London: W. Swan Sonnenschein and Co.

THE traditional method of teaching geometry in strict accordance with the original work of Euclid is here much modified.

The first book is here devoted to the straight line, the successive sections treating of angles at a point, triangles, parallels, and parallelograms. Then follow problems which in Euclid are interspersed somewhat promiscuously with the theorems, *loci*, axioms, and postulates. The second book treats of the equality of areas. There can be, we imagine, little doubt that the arrangement here followed is simpler and more rational than that of Euclid.

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# CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

## HEIGHT OF MEN.

*To the Editor of the Journal of Science.*

SIR,—In the crypt of Hythe Church are the bones of about a thousand men said to have been killed in a battle between Saxons and Danes. The size and strength of the bones are wonderful. The skulls are large and well-shaped, and have no likeness to those of gorillas except in the deeply furrowed and projecting brows. From a dozen femurs I picked one that was rather the largest, and I found it a full inch longer than my own. Taking this as a fourth of the owner's excess in height, he must have been 6 feet 7 inches. A skeleton, probably older than those at Hythe, is in Scarborough Museum, and, by rough measurement with arm-span outside its glass case, I found that the former owner was about 6 feet 4 or 5 inches. Did not giants precede the men whose small armour has led us to deem our fathers less than ourselves? I believe that we, and especially our girls of the middle and upper classes, are growing taller. I wish someone would compare the height of 200 or 300 girls, between 16 and 26, with the height of their mothers. I think he would find a difference of quite half an inch, perhaps more.—I am, &c.,

HUGH BROWNE.

## STUPIDITY OR EXCITEMENT

*To the Editor of the Journal of Science.*

SIR,—As you appear to take much interest in anima psychology, perhaps the following instance of animal stupidity may be acceptable:—The other day some sparrows flew past my house at

the height of the second-floor windows. A cat which was walking in the garden made a sudden leap upwards, as if in the hope of seizing them, though her spring did not of course carry her one-tenth part of the height that would have been requisite.

We generally suppose that every animal has a practical knowledge of the extent of its own powers, without which, indeed, it would fare badly either in capturing prey or avoiding its enemies. Moreover, we feel warranted in concluding that it knows the powers of its enemies. Thus both cats and birds know that dogs cannot climb, and when in a tree exhibit perfect unconcern. But the cat in question, though of mature age, seemed as little able to judge of distance as is an infant when it grasps at the moon.

The only other conceivable interpretation of the leap is that Puss was excited out of her sober judgment at the mere sight of sparrows.

Another case of apparent feline stupidity may often be observed:—If a canary, or other small bird, is set in its cage near a window, a cat will often post herself on the ledge outside and stare for an hour, if not driven away, frightening the bird almost to death. Now surely every cat must have learnt, from its own individual experience, that glass if pervious to light is not so to cats.

It seems to me that the great difficulty we encounter in studying the intelligence of animals is their extreme inconsistency, or, I might perhaps better say, the mixture of rationality and irrationality which they exhibit.—I am, &c.,

H. S.

[Perhaps to higher beings human conduct might exhibit the same medley of wisdom and folly which we think we find in the lower animals.—Ed. J. S.]

## EARTHQUAKES AND ELECTRICITY.

*To the Editor of the Journal of Science.*

Sir,—I would take this opportunity of referring to an article in your December issue on "Earthquakes," &c. In this it is stated —"It is now well established that in India, at all events, earthquakes are almost always accompanied by furious storms of thunder," &c. Now I have had personal experience of three earthquakes, my wife of one, and my sister (now with me) of two, all independently of the others. Neither thunder, lightning,

nor rain occurred with one of them. Each and all occurred without any atmospheric disturbance whatever.—I am, &c.,

W. BULL.

## PLACE TO OUR ELDERS!

*To the Editor of the Journal of Science.*

SIR,—From time to time naturalists are still asked how they can reconcile Darwinism, or Evolutionism generally speaking, with Revelation? If I might suggest, "Society," before seeking a solution of this difficulty, should try to obtain an answer to a less recent difficulty, *i.e.*, how the tenets of modern political economy can be brought into harmony with Scriptural morality! —I am, &c.,

TRUTH-SEEKER.

## THE SHROPSHIRE MYSTERY.

*To the Editor of the Journal of Science.*

SIR,—You have in dealing with so-called "Spiritualism" shown a decidedly benevolent neutrality, and have earned, as I can perceive, scanty thanks from both sides. You will, however, doubtless, not refuse to find a corner for the following considerations *in re* the "Shropshire Mystery," now that the alleged exposure is denied and the "confession" retracted. Setting aside trickery three cases seem to me possible:—

1. The girl produces the phenomena in question, involving destruction to property, annoyance and injury to persons, by some inherent and peculiar power of her own.
2. The girl is a "medium," through whose presence certain unseen but malignant agencies obtain facilities for doing evil. In this case she is plainly *particeps criminis*, just as much as a servant who should leave a door unlocked for the admission of burglars.
3. The mischief is produced by the malignant agencies aforesaid without the assistance of the girl and independently of her presence.

In the two former of these cases it is difficult to see that the girl is other than a criminal whose career ought to be arrested, *coute que coute*, as a danger to the community.

This consideration naturally leads me to the witch-trials of past ages. If witchcraft was a simple delusion, then, and only then, these trials and the ensuing executions were revolting outrages. But if the witches really possessed the superhuman and maleficent powers ascribed to them, or if, powerless in themselves, they enabled evil "spirits" to do mischief which would otherwise not have occurred, their elimination was then a most fortunate circumstance.

Such "mediums" are like rat-holes in a ship, or chinks in a soil-pipe, channels through which destruction and possibly death may enter.—I am, &c.,

VARRO.

## THE AFTERGLOW IN THE SKY.

*To the Editor of the Journal of Science.*

SIR,—With regard to the singular ruddy glow observed in the heavens before sunrise and after sunset, no one seems yet to have enquired whether any similar phenomenon has been recorded as occurring after former great volcanic eruptions.

An answer to this question would go far to decide the controversy between two rival astronomers (and editors) whether the phenomenon is due to volcanic dust or cosmic dust.—I am, &c.,

T. B. P.

## NOTES.

At the December meeting of the Royal Microscopical Society the death of Mr. Hugh Powell, at the age of 85, was announced. The deceased has been engaged in the improvement of the microscope since the year 1834, and his friendly rivalry with the late Andrew Ross contributed greatly to a rapid succession of improvements in the construction of achromatic microscopes. In 1840 he succeeded in making a 1-16th of an inch objective, the first produced in this country: some years later this was surpassed by him in the production of the 1-25th and the 1-50th, constructed for Dr. Beale's researches on ultimate nerve structure. Mr. Powell was the first English optician to construct objectives on the water-immersion principle, by which a vast increase in light and resolving power, together with greater working distance, was obtained. When Prof. Abbe, of Jena, demonstrated the important part played by diffraction in the formation of the microscopic images of very minute structures, and the immense gain in aperture resulting from the employment of dense media for immersion objectives in the place of water, Messrs. Powell and Lealand were the first in this country to adopt the new principle, and with such success that objectives possessing the highest aperture on record have been constructed by them. Failing health of late compelled Mr. Powell to confine his attention to computing formulæ and giving directions, which were ably carried out by his son. Mr. Powell was one of the earliest Fellows of the Royal Microscopical Society (at that time the Microscopical Society of London), having joined it at its foundation in 1840.* The object-glasses constructed under the late Mr. Powell's direction have rarely been equalled and never surpassed by those of any other optician in the world. Some of Dr. Woodward's most difficult photographic work has been accomplished by their aid, and they have rendered good service in the elaborate researches of Dallinger and Drysdale on the life-history of monads, which gave the final blow to the theory of heterogenesis, and also to Mr. W. S. Kent in his investigations on some of the most minute forms of Infusoria.

Certain meteorological phenomena are at present exciting much attention. In England the sunset skies have for many days displayed an unusually brilliant orange-red colour, whilst the moon has appeared on the south coast blue, and at London of a

* Only five of the founders of the Royal Microscopical Society now survive.

greenish blue. The sun in India is said to have been decidedly blue. We have not learnt whether its spectrum has been examined.

The "Medical Press and Circular" remarks that, in applying for medical appointments in Edinburgh, "more dependence is to be placed on being a pious Free-Churchman than on any real aptitude."

At the Meeting of the Linnean Society on the 6th ult. was read a posthumous paper by Charles Darwin, on "Instinct."

It is not generally known that Humboldt was an Evolutionist. According to Du Bois Reymond he spoke disapprovingly of the catastrophic and teleological "Essay on Classification" by Agassiz, and Parisian traditions report that he was not on the best of terms with Cuvier.

We regret to put on record the death of the distinguished American entomologist Dr. J. L. Leconte. The news reached us just too late for announcement in our December issue.

Mr. H. P. Hubbell, in a letter to the "Popular Science Monthly," describes three human footprints in a rock of magnesian limestone near the mouth of the Little Cheyenne River, in Dakota Territory.

According to the same journal Lord Chief Justice Coleridge has been put forward at Yale College to defend classicalism in education as against the study of Science. Besides very much damaging his cause, his Lordship is reported as having said "I have done many foolish things in my life,"—a most appropriate confession from an Anti-Vivisectionist.

The supposed specific bacillus of cholera has not been found to reproduce this disease in cats, dogs, swine, guinea-pigs, and rats. Mice inoculated with the bacillus have become ill.

It is very doubtful whether any portion of the profits of the Fisheries Exhibition will be applicable to the establishment of a station for the study of Marine Zoology. Popular organs denounce the proposal, and sneer at scientific investigators and their "fads."

Mr. Ivan Levenstein, in an able discourse on the decline of the coal-tar colours' industry in England, delivered before the Manchester Section of the Society of Chemical Industry, insists that only such men should be appointed to professorships as have distinguished themselves by actual research.

According to "La Nature" M. Saint Georges has devised an improvement in the telephone, by which the words spoken are registered.

M. Th. W. Engelmann, after very careful and prolonged researches, has succeeded in showing indubitably that certain Vorticellæ possess the power of evolving oxygen on exposure to light, by means of a green colouring-matter which is equally diffused in their ectoplasm, and not by means of vegetable guests. These are the first authentic instances of animals which assimilate by means of a chromophyll.

"Les Mondes" complains that "l'Hygiène Pratique," a purely non-political French journal, has been prohibited in Germany, an act explicable only by "une haine implacable pour tout ce qui est français."

Mr. G. W. Grim ("Popular Science Monthly") notices the occasional appearance of small land-birds out at sea, sometimes hundreds of miles from land, and comments on their freedom from weariness and on their tameness until approaching the land.

According to "La Nature" the mountains of Turkestan, now almost denuded, were once covered with magnificent forests.

Prof. W. G. Sumner ("Popular Science Monthly") says:—"We can never annihilate a penalty. We can only divert it from the head of the man who has incurred it to the heads of others who have not incurred it. A vast amount of 'social reform' consists in just this operation."

The Central Association of Spiritualists is being wound up, and a deficiency of £150 has to be encountered.

MM. J. Chambrelent and A. Moussons ("Comptes Rendus") have proved the presence of morbific bacteria in the milk of animals attacked by splenic fever.

Mr. Jos. Cowen, M.P., whilst distributing prizes at the Newcastle College of Medicine, complained that "the tendency of to-day was more or less in the direction of sameness and uniformity, which begat sterility and intellectual weakness."

Many animal and vegetable forms seem stationary in numbers, if not actually on the decrease. Man and those weeds and vermin which are—in a broad sense—parasitic upon him have the sad prerogative of unlimited increase.

H. A. G. Nathorst ("Botanische Jahrbücher") shows that the flora of Spitzbergen is richer than that of any other country in the same latitude. The majority of species avoid the coasts, and are mostly to be found in the interior, in accordance with Blyth's theory. Most if not all the species have immigrated since the glacial epoch, finding their way over a since submerged tract which connected Spitzbergen with Novaja Semlja, Arctic Russia, and Scandinavia. There has been no immigration of

note from Greenland, which is separated from Spitzbergen by a deep sea:

Mr. Wigner, F.C.S., in a letter to the "Times," gives some alarming revelations concerning the adulteration of milk. Of fifty samples obtained as it comes to London the total average was 7 per cent better than the standard of the public analysts. But of three hundred samples obtained about the same time from London milkmen all but ninety-seven were worse than the worst of the original samples. On the lowest computation the sum paid yearly by London for milk-adulteration is £356,000.

"Psychische Studien" and "Light" give, on the part of Gambetta and of Prince Bismarck, a number of instances of what forty years ago was considered gross superstition, such as belief in unlucky days and years, in fortune-telling by cards, in the danger of thirteen persons sitting down to table, in the influence of the moon on the growth of plants and of the human hair!

Mr. T. Mellard Reade, F.G.S., in a letter to the "Geological Magazine," maintains that the human skull found at Birkdale in 1872, on which a paper was read by Dr. Barron at the Southport meeting of the British Association, is, at a liberal estimate, not more than 2000 years old.

Prof. Dohrn's collection illustrative of the fauna of the Bay of Naples has become the property of the Cambridge Museum of Comparative Anatomy.

According to the Society for Psychic Research, impressions of odours and tastes are transferable.

The "Journal of Education" having offered a prize for "the best list of the ten greatest living English men of letters, the names selected by a majority of the candidates include three avowed enemies of Science and at least two decided Bestiarians. The name of Herbert Spencer figures near the bottom of the list!

"Science" discusses rhabdomancy, magnetic healing, &c., in an article headed "From Superstition to Humbug."

It is announced that a Zoological Society is about to be formed at Liverpool. The promoters hope to have shortly the largest and most complete zoological gardens in Europe. We hope, however, that they will be in the hands of a society, and not of a company. In the latter case they will either come to an untimely end or continue in existence by dint of attractions similar to those offered by the Royal Westminster Aquarium.

According to "Flora" the fungus *Torrubia cinerea* has been found growing upon a mature *Carabus* (species not named).

According to "Science," at the November meeting of the American Academy of Science, Dr. Graham Bell took up much time by a paper on the alleged increase of deaf-mutism, due to the existence of separate schools for those suffering from congenital deafness.

Prof. Newcome ("Science") urges that photometric determinations are comparatively valueless, because they give only a part of the radiant energy of the sun.

Dr. McCook, at the recent meeting of the Academy of Natural Science of Philadelphia, gave an interesting account of the moulting of spiders (*Tarantula*) and of the restoration of lost limbs.

"L. B." writes in "Science" on teaching language to brutes, which he thinks feasible (*see* "Journal of Science," 1883, pp. 1 and 176).

There is war, not indeed in heaven, but among the Anti-Vivisectionists! Mr. Adams, editor or late editor of the "Zoophilist," has brought an action against Miss F. P. Cobbe, and has recovered damages!

We are happy to learn that the Bestiarians have been totally defeated at Bournemouth, in spite of the Bishop of Winchester, his attending vicars and curates, and of one Mr. Vaudry, a delegate sent down from head-quarters.

M. Girard, of Lyon, has bequeathed 100,000 francs to the French Association for the Advancement of Science, for the purpose of founding a quinquennial prize for researches on the antiquity of man with reference to geological times.

From a careful study of the "red spot" on the disc of Jupiter, Dr. Lohse, of the Potsdam Observatory, concludes that this planet must still be enormously hot, occupying an intermediate position in the scale of development between the cooled and solidified planets, such as our Earth and self-luminous bodies like the Sun.

Strange to say "doctors differ" on the cause of the glow which has lately been observed in the western sky after sunset. Mr. Norman Lockyer ascribes the phenomenon to volcanic dust, whilst Mr. Proctor has no doubt of its cosmic character.

Mr. W. H. Preece argues that the mass of matter projected into the air during the recent eruptions was negatively electrified and then became subject to the repulsive force of the electrified earth, whilst the particles repelling each other caused the dust to spread over a vast area.

Sir F. Abel, F.R.S., has been elected Chairman of the Council of the Society of Arts, *vice* Sir W. Siemens, deceased.

A technological contemporary indulges in the following specimen of popular science :—" Sir Isaac Newton, the celebrated author of ' Kosmos,' was once asked how he came to make his great discoveries ? "

Prof. Holton, of Copenhagen, refutes the alleged claim of Romagnosi to have anticipated Oersted in the discovery of electro-magnetism. He shows that, according to the description given by Tommasi, Romagnosi's advocate, the phenomenon produced and recorded by the latter was not electro-magnetism.

Major-General J. F. Tennant, F.R.S. (" Monthly Notices Royal Astronomical Society "), from observations on a chronometer, is led to infer that the periodic changes in its rate are due not to variations in temperature, but in humidity.

According to the French medical papers there is now living at Aubérine-en-Royans, a village between Valence and Grenoble, a woman who has reached the age of 123 years, and she has no infirmity except deafness. Her marriage certificate bears the date 1783.

Prince Louis Ferdinand, of Bavaria, is about to bring out an anatomical monograph on the tongue in man and in the lower animals.

The " Popular Science News " declares that " English lecturers as a class are prosy and dull."

Canon Liddon, in a Lecture on Positivism,—a doctrine, to say the least, not more welcome to the scientific than it is to the religious world,—asks how could we " face the weird mystery of pain unless we felt that suffering had a purpose, and that each stone in the great temple of souls needed to be chiselled, and that each blow was dealt by the unerring hand of the Great Sculptor ?" Are we to infer that the speaker eschews every attempt to escape from or to do away with pain ?

Miss F. P. Cobbe has had the effrontery to speak of Professor Owen as an " old impostor."

An abnormal number of toes is, according to Mr. E. P. Poulton, not uncommon in cats. This peculiarity is hereditary.

A medical contemporary, *haud inepte*, speaks of water-closets as, " except when perfectly managed, mere typhoid fever traps."